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Cover: Photograph of the moon, age 22 days, taken with a 36-inch refractor.
—Courtesy Lick Observatory, University of California

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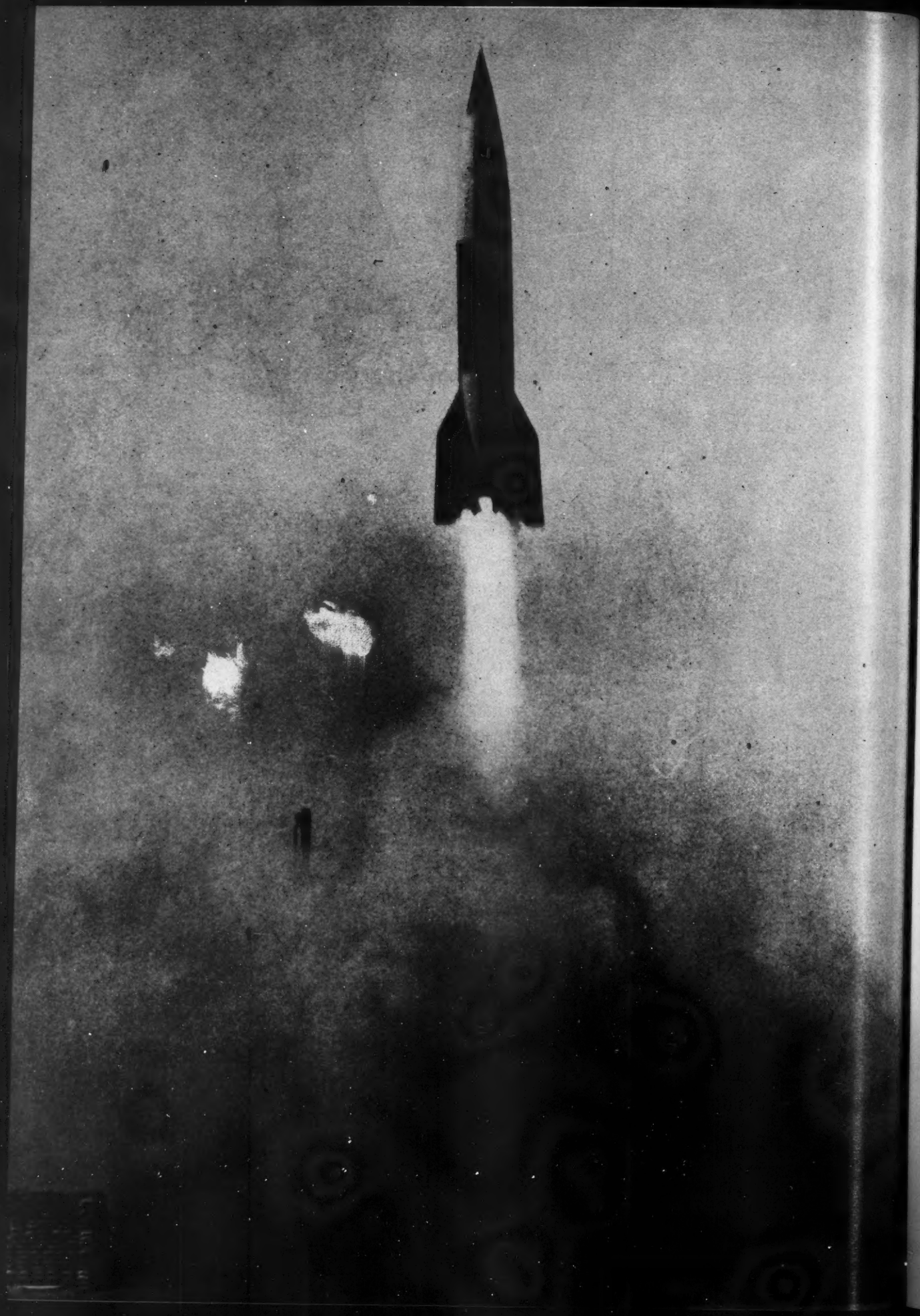


NEXT STEP SPACE

By ALVIN L. FELDMAN, ME '49
with Ben-Ami Lipetz

The problem of interplanetary flight is one of long standing. Theoretical investigations have resulted in the formulations of several possible solutions, two of which show great promise. The older of these two theories is that of rocket propulsion. However, the newly conceived idea of the atomic powered athodyd (ramjet) merits consideration in any discussion of space flight.

The fundamental difference between an athodyd and a rocket lies in the fact that while a rocket carries all of its own fuel and oxidizer, the jet powered athodyd requires a fluid medium for its operation. The rocket achieves its peak efficiency while operating in a vacuum where there are no frictional losses, while the ramjet requires an atmosphere. In this article attention shall be focused on space flight using the athodyd.

Operation of the Ramjet

The principle of operation of the ramjet is very simple. An athodyd (see Figure 2), is a thermo-jet unit which takes in air at one end, as indicated by the arrows, heats it up, and then discharges the highly heated gases from its tapered nozzle. This discharge provides the propulsive thrust, and naturally, as the athodyd goes faster and the mass of the gas flowing through the heating unit increases, the velocity of the ramjet in the air will become greater. The athodyd does not begin to approach any worthwhile efficiency until it reaches a sonic velocity at which time the air has a tendency to ram up in front of the intake, for which reason it is often called the ramjet. This is a very general treatment of an extremely complex subject but it should prove sufficient for the purposes of this article.

Let us consider a hypothetical flight to the moon in a spaceship using the ramjet. Such important items as the shape, mechanical design and the construction of the spaceship are just as well left to the reader's imagination.

The Take-Off

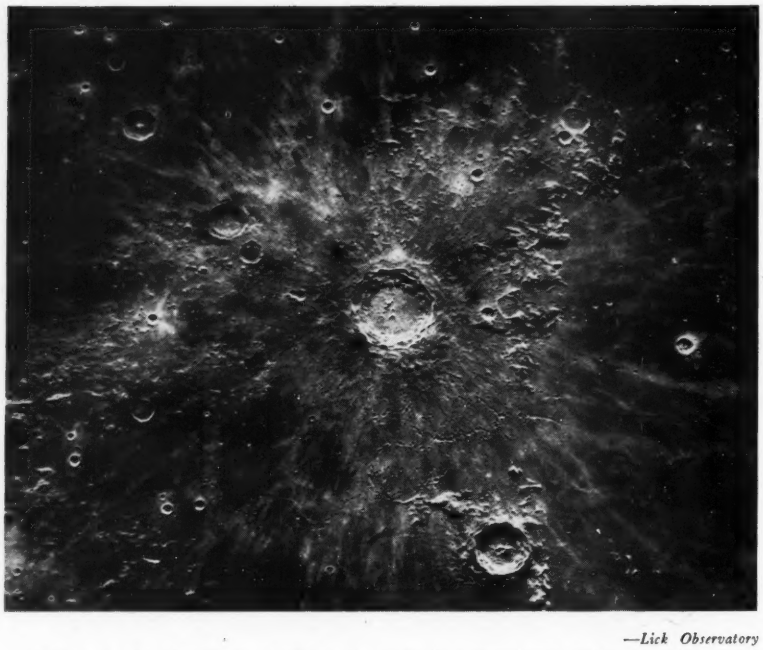
The spaceship is set up on a slightly inclined launching rack and when last minute preparations for the flight have been completed a set of rockets attached to the sides of the vehicle are ignited and serve as carriers to get the craft up to the necessary sonic velocity. When this velocity is reached, the booster rockets are switched off and the aircraft is powered by the athodyd. As long as the athodyd is up to a sonic velocity when it takes over power, and as long as the fuel consumption is gradually increased, the athodyd will go faster and faster. As more gas is discharged out of the rear an increase in velocity occurs, and this increase in velocity causes more gas to enter the intake which will tend to increase the velocity again. As the athodyd goes faster its altitude increases, and with the aid of small wings of a very flat airfoil section the craft gains altitude. This makes the situation one in which there is a continually rising ship with a correspondingly increasing velocity. The spaceship continues that way until it reaches a velocity of approximately five miles per second, at which time the force of gravity is equalized and it becomes necessary to invert the airfoil of the wings in order to cling to your orbit around the Earth. In this inverted airfoil position you would continue to circle around the Earth as your velocity builds up to the velocity of escape of the Earth, or 6.98 miles per second. When this velocity is reached you continue to circle the Earth until you reach the predetermined departure point of your orbit. When you reach that point you fold in your wings, cut the motor, and shoot off at a tangent to the arc shown in the diagram of a potential orbit. (Figure 3).

The velocity of escape is the velocity required to enable a body to escape the immediate gravitational field of the planet on which it is located. The value of the velocity of escape can be simply calculated by using the Newtonian relationship: F=MxA. The velocities of escape from several planets are shown on the accompanying table. (Page 8.)

At the velocity at which you are traveling it would take approximately three days of constant deceleration (due to the Earth's still present gravitational force) before the immediate field of the Moon is reached. From there on in, great care is taken to keep your orbit

A V-2 rocket starts towards the stratosphere. Some day Man may pierce the stratosphere—and return.
—Courtesy G.E.

People generally scoff at predictions of far reaching changes which would affect the general pattern of our lives. This article is intended for those who can envision the fast approaching day when mankind will break its earthly bond and achieve interplanetary flight. Advances made in rocket and jet propulsion during the war have brought this day into the reasonable future. The eventuality of successful space flight can not be laughed off as fantastic but must be considered in the cold light of science.



—*Lick Observatory*

Figure 1. The Copernicus Area of the moon is a prominent landmark which could well be used as a reference point in correctly aligning the orbit of a space ship.

aligned correctly, and this could be done by frequently taking sights on such prominent landmarks as the Copernicus Area, two views of which are shown in the illustrations. (Figure 1, cover).

This period of free coasting would give you plenty of time to catch up on your reading although you would probably be more interested with several strange occurrences which would confront you. Typical of these would be the phenomena of taking a step and gently continuing to rise until you reached the ceiling; finding yourself unable to pour water from a pitcher; lifting soup with a spoon and having to grab for it as it continued past your head; and being able to stroll on any of the six surfaces of your cabin. Those effects and many others are caused by the absence of your accustomed gravitational attraction. However they may be eliminated by the creation of an artificial field if the accelerations and decelerations are properly controlled.

Landing on the moon is a rather delicate affair and there are several methods of going about it. The first and the simplest to use—but probably not the safest—is to have the ship equipped with a series of proximity fuses so attached that as the craft gets nearer and nearer to the moon it ignites the booster rockets, so attached as to provide a reversed thrust. By having them timed properly it is possible for the decrease in velocity to be fairly gentle. The other possibility, more highly thought of, is that of the braking ellipses. This theory is explained in the subsequent description of the return trip and shall not be gone into at this time.

Atomic Fuel Proposed

At this point the reader is probably wondering how we got the power to provide the heat necessary to escape the Earth's field by means of an athodyd.

In the ordinary athodyd the heat is supplied by the burning of some combustible fuel such as gasoline or kerosene. However, the athodyd for use in our spaceship to the moon shall derive its heat energy from rods of some fissionable material such as uranium or plutonium.

These rods would not be of pure uranium but would be a mixture of beryllium oxide and uranium, the purpose of the beryllium oxide being to make the uranium a refractory substance and to prevent it from oxidizing to the stage where it would start peeling and melting. No generating equipment is needed to start the fission of the uranium because as soon as it is installed this fission begins to occur. When fission occurs in uranium or plutonium we shall assume that two neutrons are emitted. These two move about until they come in contact with atoms of uranium, at which time they cause the emission of two more neutrons from each of the atoms. This continues to occur and if left uncontrolled too long would result in a chain reaction of great magnitude probably causing a dangerous explosion.

Boron Controls Reaction

To prevent the chain reaction from advancing too far, use is made of boron rods which have the property of absorbing neutrons very well. The number of neutrons to be absorbed by the boron can then be controlled by the amount that the boron is inserted into the heating chamber of the athodyd. Because of leakage, in actuality, only about half of the neutrons that are emitted cause fission, but three quarters of one percent are delayed about ten seconds, and these are the ones that are controlled by the boron. Naturally, in order to have a steady state of energy produced, the thing to do would be to insert the boron to that depth such that it would exactly absorb enough neutrons to bring the loss due to leakage up to fifty per cent. Therefore the number of neutrons in the chamber would be kept fairly constant in as much as every time two new neutrons were produced one of these would be lost

	Gravity at Surface G	Escape Velocity m.p.s.	Escape Velocity m.p.h.
Earth	1.000	6.98	25200
Moon	.012	1.47	540
Mars	.380	3.10	10160
Venus	.850	6.30	22680

due to leakage, leaving the total the same as it was before. If more boron were placed in the chamber the result would be that more neutrons would be absorbed, leaving fewer neutrons wandering around to cause fission. If such a thing were done the effect would be to leave a smaller available percentage of free neutrons, bringing it from, shall we say, fifty per cent to forty-nine per cent. This would have the effect of causing a gradual decrease in the heat energy released.

If the operation were to be reversed the percentage might for example rise from fifty per cent to fifty one per cent. In this case you would have a gradual increase in the amount of heat energy. As the reader can see, by sensitive adjustment of the setting of the boron the energy output of the uranium can be controlled to an exceptional degree. It should be once again noted that although only three quarters of one percent of the neutrons emitted are immediately controlled by the boron, this is quite enough to control the balance of the reaction and therefore the direction of the changes in energy output.

In an athodyd of this type the control of the boron would be of the utmost importance because if the amount decreased very rapidly, there would appear an immediate increase in the number of neutrons which would probably result in a chain reaction of great magnitude. To avoid an occurrence of this nature the likely thing to do would be to insert in the chamber a form of thermo-couple or thermostat which would automatically control the setting of the boron so as to keep the magnitude in the desired range.

The advantage of this atomic powered athodyd is self evident when it is realized that one gram of uranium will provide the heat energy equivalent to the burning of 358,000,000 pounds of Pennsylvania Anthracite coal.

Army Holds Patent

The idea of using atomic fission to provide the heat energy to run an athodyd was first proposed by Dr. R. P. Feynman of the Cornell University Physics Department. Dr. Feynman conceived the idea while working at Los Alamos on the atomic bomb and the Army patented the theory for him.

Returning to our space ship on the moon we are confronted by the all important problem of getting back to the Earth. This problem is not quite as difficult as it might seem. Probably the easiest solution would be simply to convert the athodyd into a large rocket. This could be done by bolting a suitable plate over the front end of the combustion chamber, replacing the old nozzle, and replacing uranium rods with fuel injectors suitable for the rocket fuels. At this point it must be kept under consideration that the velocity of escape of the Moon is much less than that of the Earth, and, in fact, a velocity of only 1.47 is all that would be required to escape the Moon's immediate gravitational field and start falling towards the Earth. Taking off from the Moon is done rather simply in comparison to the take off from the Earth. The take-off consists of only blocking up the front of the rocket with any native materials available and firing the main rocket, directional control being maintained by the boosters. Once off the ground the ship circles the Moon until it reaches the necessary velocity of escape at which time the rocket leaves its circular path at a predetermined point and proceeds in its planned orbit to the Earth. (Refer to Figure 3).

—"Rockets and Jets" by H. Zim

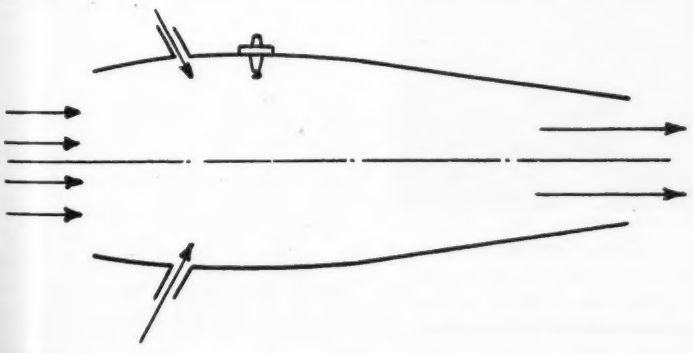
Figure 3. A typical orbit for a flight to and from the moon.

Braking and Landing

Landing on the Earth is accomplished by means of the previously mentioned braking ellipses. (Refer to Figure 4). The pilot of the vessel could control his path by means of his offset booster rockets on the sides of the ship so that he misses the Earth by a matter of some 250 miles. In doing this he grazes the fringe of our atmosphere, and this slows him down to slightly below the velocity of escape of the Earth so that from then on the ship is a satellite of the Earth. As shown in the figure, the ship, after it grazes the atmosphere, will shoot out but at a reduced speed and in an elliptical

(*Continued on page* 30)

Figure 2. A simplified diagram of the athodyd, or ramjet. Gas entering the chamber is highly heated by means of a fuel and discharges from the tapered nozzle, causing a propulsive thrust.



The Engineer And The Scientist

PROF. HENRY E. GUERLAC '32
Professor of the History of Science

There is much talk in the popular press these days of scientific method, and of the importance which scientific knowledge has had for society. No one would seriously question the emphasis upon the research man, the first in line of those who make scientific discoveries available to us, yet this is apt to lead to an unwarranted telescoping of the overall process by which scientific discoveries are first made and then made available. In most such discussions the emphasis, perhaps quite properly, is placed upon the first stage of the process, easy to distinguish and to dramatize. Yet as every engineer knows full well a long and difficult path must always be traversed before even the simplest technical idea can be reduced to wide practice. The steps involved require the intimate cooperation, or at least the successive attention, of men with different specialties and with widely different talents and temperaments.

In a hypothetical case the work of the mathematician lies back of the experiments of the physicist or the chemist; these men are then followed by the engineer, the entrepreneur, the contractor, or the production man; and these in turn require the services of the banker, the lawyer, or the patent attorney; perhaps, also, of the economist, the psychologist, or the expert on labor relations, before a new device can be made generally available. It was the great achievement of the industrial revolution of the 18th and early 19th centuries to organize the production of goods by the factory system aided by the financial techniques, the new sources of power, and the new machines associated with it. But, as has often been pointed out, the greatest invention of the late 19th and early 20th centuries, and which supplemented the earlier developments, was the invention of the art of inventing. This has usually meant the organization and financial support of research, and the founding of industrial laboratories.

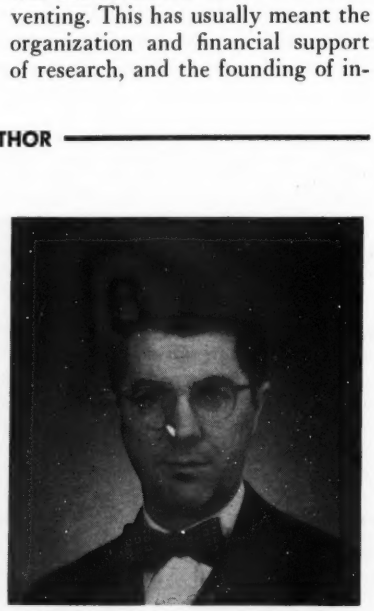
Although I do not wish to underestimate the great changes that have taken place on this score, I prefer to emphasize how much our modern industrial society owes to the elaboration of a system more all-inclusive for insuring the successful and economical development and promotion of the ideas emanating from research. This process has entered into the very fabric of our industrial organization and has contributed some of the most familiar characteristics of modern industrial life. The recent heated discussions of patent reform, of the necessity for a National Science Foundation, to say nothing of the debate concerning the role of atomic energy in the modern world, have shown that these problems are inextricably associated with basic and sometimes controversial questions of the structure of our society.

Modern Teamplay

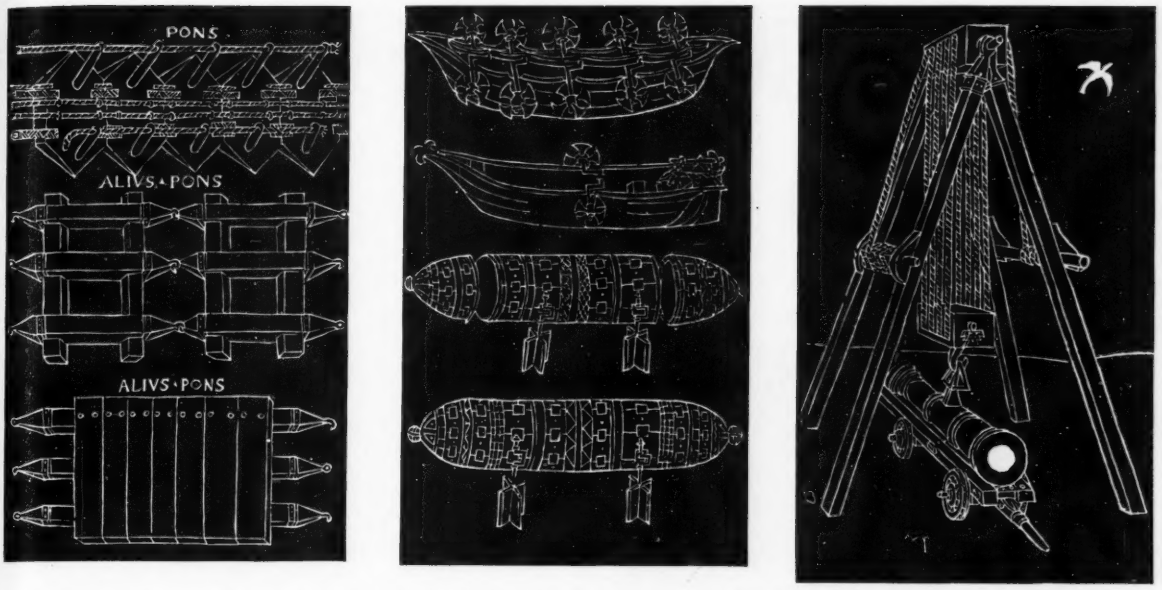
Our age of great specialization has so multiplied the steps which a discovery must go through before it can see the light of day, that the process itself is hard to discern and difficult to describe. The very complexity of the process has led the general public to over-simplify it. We fall back on the device of describing it in the terms of a hundred or so years ago when the process was summed up in the figure of the solitary inventor. Either the inventive genius combined a number of the required talents in himself (as did Fulton, McCormick, Eli Whitney, Edison, and others who were promoters, entrepreneurs, and publicity men all in one) or else he joined the swelling ranks of those whom society passed by and left to die in obscurity, while some more favored or fortunate individual brought the invention into

THE AUTHOR

Born in Ithaca, Professor Henry Guerlac attended Cornell University, receiving a bachelor's degree in chemistry in 1932 and an MS in biochemistry in 1933. He was an assistant, Junior Fellow, and, later, an instructor at Harvard where he received a Ph.D. in history in 1941. The same year he established a Department of the History of Science at Wisconsin. Since 1943 he has worked with the OSRD, preparing a complete history of radar development which will soon be published. Last year he returned to Cornell as professor of the history of science, the first man to receive the title at this University.



Prof. Guerlac



Illustrations from the first engineering book to come off the printing presses of Europe. This military encyclopedia was written in 1460 by Roberto Valturio, and published in 1472 with woodcuts showing various military devices. *Left to Right,* Transportable bridges; Paddle-wheel boats; Block-an-tackle for hoisting cannon.

being. A few men made effective partnerships, like that of James Watt and Matthew Boulton, in which the talents of one supplemented the defects of the other. But the frequent instances of inventors who died in poverty, or of brilliant inventions that failed or stagnated for lack of proper development or encouragement, call attention to the importance of the teamplay which modern society has perfected to bring scientific discoveries into use.

Mutual Criticism

We are all familiar with the slight snobbishness with which the partners in this enterprise sometimes characterize one another. This is usually harmless and serves to accent the contrasting talents required at the various stages. To the physicist and chemist the mathematician seems to live in a mysterious unreal world and to be addicted to worrying more about rigor than utility. To the engineer the physicist is an impractical fellow who feels all has been accomplished when a principle of nature has been demonstrated or a haywire model has successfully embodied a possible application of such a principle. Further, by the harassed business departments of an industrial concern, the technical people are lumped together as impractical idealists to whom costs and overhead and volume production are frequently less important than ingenuity or excellence of workmanship. This mutual criticism sometimes provides useful correctives to the extreme attitudes which these caricatures typify; sometimes it has been known to produce serious friction.

The engineer finds himself at the most interesting, perhaps the critical, point of transition in this process of development and application. We know he is supposed to embody an idea in a useful device, or to modify a discovery in order to make it "practical." What this seems to imply is that the engineer occupies the strategic point at which *the human factor* becomes involved in what up to that time may have been a purely scientific or a purely abstract problem. The engineer must design something to serve human needs (either real or fabricated); the device he perfects must run, not for a specially qualified master, but for any intelligent operator or even for the average consumer without technical skill and sometimes without common sense. It is the engineer's job to simplify and standardize as much as possible, to facilitate manufacture; to make the device sturdy in order to reduce its maintenance and enable it to withstand incredible punishment. It must be as cheap as the required performance will allow; it must be attractive in external appearance.

The Middleman

Thus the design and development problems of an engineer are summed up in the necessity of adapting an idea or a scientific discovery to human needs, human frailty, and not infrequently to human whims and prejudice. In this process the engineer must frequently mediate between the research man (who may protest to see sacrificed the performance of which his specially nursed experimental model is often capable) and the production and financial experts (to whom the feature of simplicity, cost, volume, and so forth are paramount). His influence is exerted in both directions. It is no longer possible for him to be described as one who passively adapts scientific knowledge. The engineer has always exerted, directly and indirectly, an effect upon the course of science itself. His influence is almost certainly bound to increase as time goes on. He is affected more swiftly than he once was by the developments in the scientific laboratory. The lag between research and development is being sharply reduced.

From both sides the gap that has

(*Continued on page* 32)

THE MOUTH AND

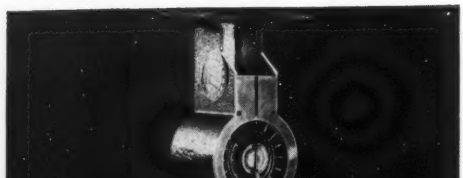
"Bearings, 050; range, 2000 yards —fire salvo!" Seconds later, out of the black of night, shells guided by the omnipotent eye of radar would strike the heart of the enemy fleet . . . Five thousand feet above a blanket of clouds which cover the city, the radar operator of the Flying Fortress pressed a button and tons of bombs dropped straight onto targets never seen by eye. This was America's greatest weapon in use: Radio Detection and Ranging.

Why did the enemy never equal the long range and deadly accuracy of *our* radar? The principles had long been known, and radio detection devices were common knowledge among scientists.

The great secret was the magnetron—"Maggie." The British introduced the resonant cavity type magnetron, and the development and production of Maggie reached great proportions in America.

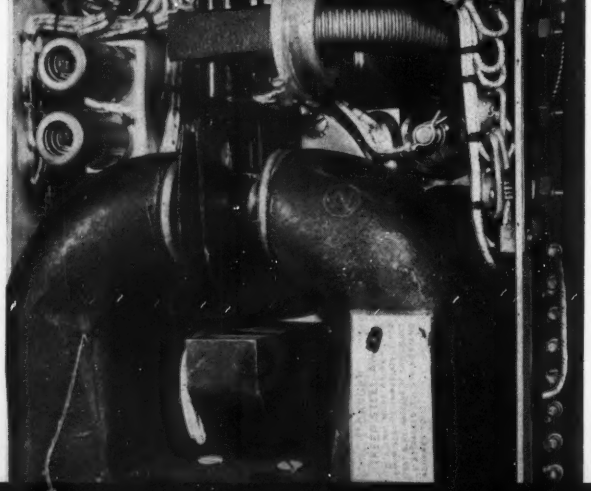
Radar uses microwaves of a very short wavelength, from 70 cm. down to 1 cm., because they travel in a straight line, as does light. Until Maggie was introduced, it was almost impossible to produce any large amount of microwave power.

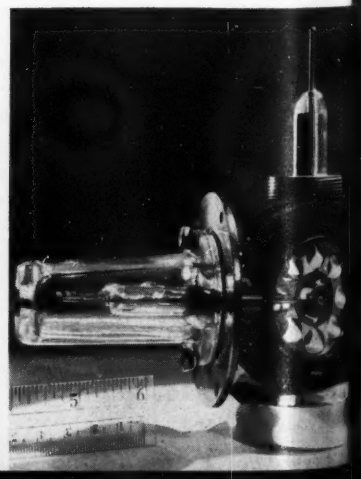
However, Maggie, essentially a series of resonating cavities (a metallic cavity which acts the same as a coil-condenser tank circuit) in which the electrons are whipped about with the aid of high voltage pulses and a strong magnetic field, was able to induce large amounts of ultra-high frequency



Above: The inside works of a 3 cm. magnetron. Cathode heater connection comes up from bottom, output is taken from wave guide at top.

Below: A 3 cm. magnetron mounted between pole faces of a strong magnet, from which the tube gets its name.





Right: Cutaway view of 10 cm. Maggie, capable of 240 kilowatts peak output. Cavities are clearly visible. Cathode connectors are enclosed in the glass insulator to left, coaxial output on top.

EARS OF RADAR

power in a length of wire projecting into the varying field.

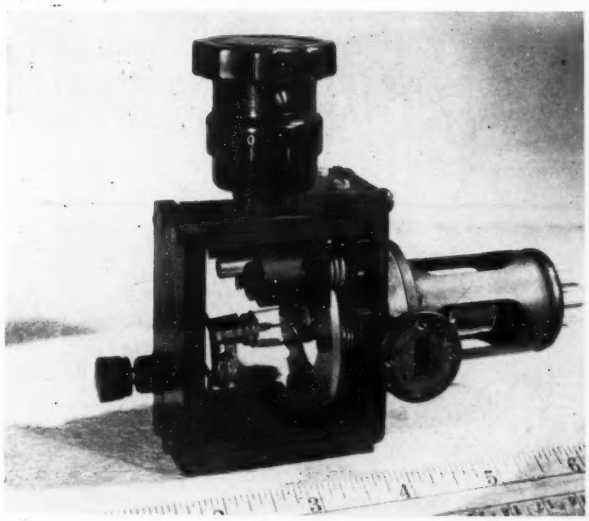
It is no unusual feat for a Maggie to put out 700,000 watts of radio-frequency power varying at a rate of 10,000,000,000 cycles per second. A man-killing voltage of 12,000 volts is applied to Maggie, who is small enough to be carried with ease in your coat pocket. Maggie packs a mean wallop, and used in a radar transmitter will throw her voice from here to New York.

And so we have Maggie shouting at a target. Her voice, the radio-frequency pulse of power, is reflected from the target and comes back to the source, like any other echo. In order to hear the microwave echo, it must be converted to a frequency at which it can be detected, amplified, timed, and presented visually.

The tube most commonly used for this purpose is a very low power microwave generator known as the klystron. Klystron, in Greek, means the breaking of waves upon the shore, which is an action analogous to the behavior of the electrons in this tube. The klystron depends on a resonating cavity to determine frequency of oscillation. The klystron cavity is easily tuned and is thereby ideally suited for use in receivers.

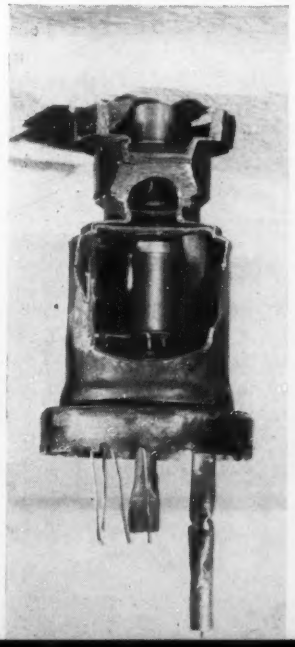
Today both of these tubes are finding wide utility in every field from the investigation of the nature of matter to making better electronic egg-cookers.

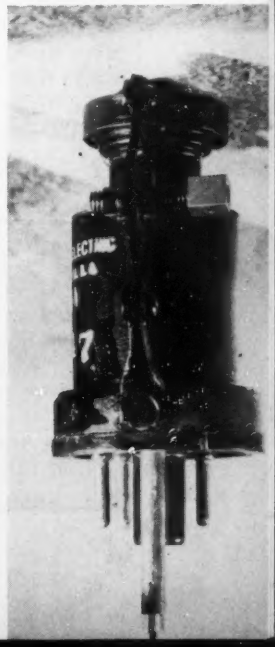
—All cuts courtesy Westinghouse

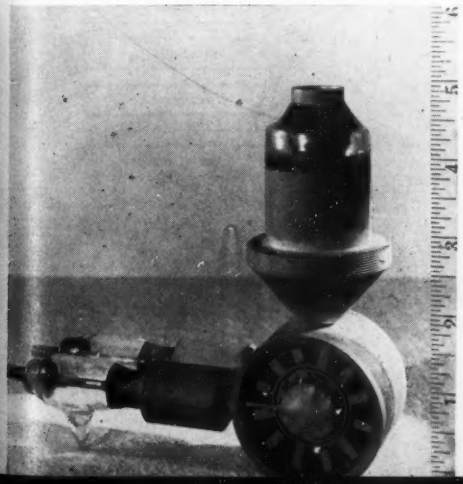


Above: A 1 cm. klystron designed as local oscillator for radar. Knob at top adjusts tuning cavity, springs and screws shown are part of temperature compensating device.

Below: A 3 cm. klystron in two views, shown right side up as used in operation. The square head screw controls the separation of the bowed struts which in turn control the gap spacing of the cavity. Tube extending through base is coaxial output.







Left: A 10-cm magnetron with a peak power output of 700-kw. The cavities are formed by brazing vanes into a cylindrical shell.

INDUSTRIAL ACCIDENT PREVENTION

ACCIDENT PREVENTION PAYS DIVIDENDS . . . HERE IS A REVIEW OF THE HISTORY AND DEVELOPMENT OF THIS IMPORTANT PHASE OF INDUSTRY

By LAVERNE R. ANDERSON, EE '47
Gerard Swope Fellow

Industrial accident prevention has received scientific study only since the turn of the century. Before the Industrial Revolution, most of the workers in this country were self-employed or employed by small businesses using mostly hand tools. Under these conditions, accidents and injuries were infrequent and were the responsibility of the injured person. As industry became more mechanized and hired larger numbers of people, however, the conditions in the factories became so poor that injuries were very prevalent. The employer admitted no responsibility for these accidents and the workers were forced to pay the costs out of their own pockets. Gradually social and moral pressure forced the states to pass workmen's compensation laws which have made the employer responsible for the damages due to accidents occurring in industry. As these laws became stronger, employers began to realize that it might be cheaper for them to try to prevent accidents than to pay the bill after the accident had occurred.

THE AUTHOR

Laverne R. Anderson received his B.E.E. degree this February and is now doing graduate work here at Cornell. For his biography, see "Prominent Engineers," Vol. 12, No. 4, of the CORNELL ENGINEER.

In more recent years this reasoning has been further strengthened by the knowledge that the major costs of accidents are not the costs of compensation insurance premiums, but are the hidden costs. The following estimate for 1940, illustrates the huge amount of the incidental costs of accidents to the U. S. employer.

	Millions
*Wage loss (worker)	$490
Cost of insurance	110
Medical expense	80
Other employer's costs	2,000

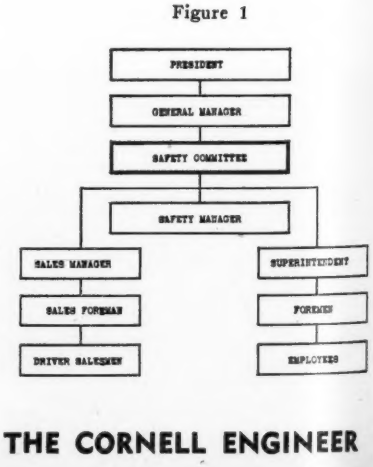
Although these incidental costs may seem too high, it is generally accepted that a conservative ratio between the hidden and direct costs of an accident would be about four to one. These hidden costs include the costs of ruined equipment, time loss of employees other than those injured, lowering of factory efficiencies, and other less important factors. With these figures in mind, it becomes evident that management can afford to spend a great amount of money on accident prevention since returns are forthcoming.

Scientific Prevention

Once management was convinced of the dollars and cents value of efficient accident prevention, it became necessary to place the study on a scientific basis so that the methods could be somewhat standardized. To do this it is necessary to accept some definitions and fundamental ideas that are now in general usage:

First, the word *accident* can be defined as "any happening that disrupts or delays the planned course of events." This is somewhat different from the usual meaning associated only with accidents which produce injuries. In actual practice many thousands of accidents may occur before anyone is injured. Second, the *cause* of the accident shall be defined as the "thing or action that shall be corrected to prevent the recurrence of an accident." Third, there are five basic factors in an accident sequence: (1) social environment (2) a fault of some person (3) unsafe act of a person and/or a mechanical or physical hazard (4) accident and (5) injury. Heinrich has likened these to dominoes stacked in a line. When the first dominoe is tumbled, it will hit the next one and so on down the line until the last dominoe, injury, is tumbled. If, however, we can re-

Figure 1



*U.S. Bureau of Labor Statistics.

move the central factor, the unsafe act or physical hazard, the chain of events is destroyed and the accidents and injuries will be forestalled. The major problem of the accident prevention campaign, therefore, is to detect and eliminate this central factor in the accident sequence.

The Safety Committee

An important force in the elimination of accidents in any business should be an organization that can efficiently direct all safety operations. Such an organization as depicted in Figure 1 might be suitable for a small plant. The membership of the safety committee would consist of the safety manager, the foremen, the office manager, the sales manager and the superintendent. In many cases workmen have been included in this committee with excellent results. The main function of this committee is to discuss major accident producing conditions and to take remedial action.

The safety manager might serve as the secretary of this committee and attend to the paper work. He should make periodic checks of all grounds and buildings and make reports on their condition to the committee. It has been found that general safety conditions can be appraised by observing the housekeeping, safety equipment, maintenance, and provisions for worker comfort. Although the safety manager can make some sort of estimate of the general safety conditions by such a survey, the safety committee must depend on the actual accident reports for finding most of the causes of accidents.

The essentials of a good accident report are given in the *Heinrich Cause Code* as (1) the "agency" or the object most closely connected with the accident; (2) the part of the agency; (3) the unsafe mechanical or physical condition; (4) the type of accident; (5) the unsafe act; and (6) the unsafe personal factor.

This is illustrated by the following example of an accident report:

1. Agency—punchpress.
2. Part of agency—die.
3. Unsafe mechanical or physical condition—no guard.
4. Accident type—caught in, on or between.

Example 4a

JOB BREAK-DOWN SHEET FOR TRAINING MAN ON NEW JOB

PART: Slide Base 235310 OPERATION: Rough cut for Milling Dovetail

IMPORTANT STEPS IN THE OPERATION Step: A logical segment of the operation when something happens to ADVANCE the work	KEY POINTS Key point: Anything in a step that might— Make or break the job. Injure the worker. Make the work easier to do, i. e., "knack," "trick," special timing, bit of special information.
1. Run up table by hand	Slow when nearing cutters
2. Feed 1 inch by hand	
3. Stop machine and run back table	Never run table back while cutters are in use
4. Check cut	Location and finish
5. Set feed	
6. Start machine	
7. Finish cut	
8. Check	

Figure 2

5. Unsafe act—removal of guard.
6. Unsafe personal factor—wilful disregard of instructions.

With a complete report on hand, it is possible to classify the accidents; and, if a major trend is indicated, the committee can act. If the case seems isolated the safety manager or the foreman will handle the case himself.

New Construction

The methods of eliminating accidents, once causes are discovered, are many and varied. If new construction is planned, the committee should play an active part in seeing that every part of the plant is laid out with safety principles in mind. It has been found that a major fault with many plants is that there is inadequate storage space and not enough room in the aisles for material to be moved safely. A defect of this sort is most easily circumvented in the new construction if adequate attention is given at the time of drawing the prints for the plant.

If the basic cause is a mechanical or material fault such as defective machinery, improper planning, or poor working conditions, the committee must impress the management that steps should be taken to alleviate these conditions. All machinery with moving parts should be guarded as completely as possible. With all the different types of guards, we must be content to say that there are few cases where the guard can be made foolproof. A worker can, if he so desires, render unworkable almost any guard ever made.

A vivid example is provided by the case of the punch press operator in a light metals plant. His press was provided with a "point of operation" guard, a non-repeat device on the foot pedal, and he was given a tool whereby he could remove any

(*Continued on page 26*)

News of the College

DuPont Fellowships

The DuPont Company announced on January 29 that it is awarding seventy-five post-graduate and post-doctoral fellowships to forty-six universities for the 1947-48 academic year. Of these, four were awarded to Cornell University: one post-graduate fellowship in chemical engineering, one post-graduate fellowship in mechanical engineering, and one post-graduate fellowship and one post-doctoral fellowship in chemistry.

Each post-graduate fellowship provides $1,200 for a single person or $1800 for a married person, together with a grant of $1,000 to the university. Each post-doctoral fellowship carries an award of $3,000 with a grant of $1,500 to the university.

The selection of nominees for the awards and choice of problems on which they are to work is left to the universities. The individual is under no obligation with respect to employment after he completes his work under the fellowship.

Tau Beta Pi Fellowships

Tau Beta Pi's 14th Fellowship Program is under way. Completed applications were submitted by February 15 and the six winners will be announced by the Fellowship Board about April, 1947. Stipends for these fellowships—for which all members of Tau Beta Pi, national engineering honor society, are eligible—have been increased from the pre-war $650 to $1,000 for a year's graduate study in engineering at the university of the fellow's choice.

The amount of the stipend was based upon a complete study of the average cost of a year's study at leading universities throughout the country. It has been customary for the institution of the fellow's choice to remit tuition and fees, and several colleges have indicated that they will continue that practice next year.

In determining to whom fellowships will go, the Board will be governed by the practical consideration that they be allotted to students who could not pursue advanced work without financial assistance. Beyond that, preference will be given to those who show unusual promise of substantial achievement, particularly those who have some definite plan or purpose in view. Applications were welcomed this year from Tau Beta Pi members who have already graduated; ex-servicemen were thus granted full consideration along with members of the class of 1947.

The Program is being conducted this year by Director of Fellowships Philip A. Singleton, Assistant to the President of Monsanto Chemical Company. The Board includes Mr. Singleton; William C. White, Director of Day Colleges, Northeastern University; Roland A. Kampmeier, Tau Beta Pi Fellow No. 21, chief of the Power Economics Division, Tenessee Valley Authority; and Joseph C. Wagner, personnel supervisor, Texas Oil Company.

A total of eighty-two Tau Beta Pi fellows have taken graduate work since inauguration of the Program in the 1929-30 school year.

Honored By Rensselaer

Dr. Arthur S. Adams, provost of Cornell University, was honored by Rensselaer Polytechnic Institute on February 1 with the honorary degree Doctor of Engineering.

Dr. Adams was the principal speaker at the RPI commencement exercises at 11:00 a.m. when bachelor degrees were awarded to 167 seniors, and advanced degrees to 15 graduate students .

The honorary degree was presented to the Cornell provost "in recognition of his particular contribution to the Navy training program." Dr. Adams was officer-in-charge of the administrative section of the training division, Bureau of Naval Personnel, in Washington during the war, responsible for some 1500 naval training schools throughout the country, of which the school at Rensselaer was one.

In his commencement address, Dr. Adams spoke on the premise that "the graduation ceremony provides an excellent opportunity to review in bold outline the significant features of the graduate's educational experience up to this point and to identify those that seem most significant for his further consideration as he continues the profoundly complex processes of living a life."

AFA Meeting

Professor J. O. Jeffrey of Cornell gave the last in a series of talks on "Metallurgy" at the February 14th meeting of the Central New York Chapter of the American Foundrymen's Association, in Syracuse.

Jeffrey's talk was followed by three separate round table discussion groups. The Malleable Section was under the direction of Jack Sibbison. of the Malleable Society. G. M. Thrasher, of R. Lavin & Sons, Elmira, led the Non-Ferrous group and J. F. Dobbs, superintendent of the metallurgical and physical laboratory of the New York Air Brake, headed the Grey Iron Section.

Club Forum

Harry J. Loberg, professor of administrative engineering, Cornell University, participated in a forum in February titled "Educating the College Professor," held at the Engineer's Club in Philadelphia and sponsored by that organization.

Loberg spoke as a representative from the field of mechanical engineering in the rebuttal to briefs given by practicing engineers expressing their views on present methods in education.

(*Continued on page* 50)

PROFILES
OF OUTSTANDING ALUMNI

John Lyon Collyer, M.E. '17

John Lyon Collyer, M.E. '17

John Lyon Collyer entered Cornell University directly from the Cascadilla School of Ithaca in 1913. After completing the regular four year course he received the degree M.E.

During his stay at Cornell, Mr. Collyer was especially active in many extracurricular activities, but definitely left his mark by leading the Cornell Crew that toppled Univ. of California oarsmen in the Poughkeepsie Regatta. Mr. Collyer stroked both the freshman and varsity crews. In his junior year he was elected Captain and during his senior year actually coached the crew during the illness of "Pop" Courtney. Besides Crew, Mr. Collyer was also a member of Chi Phi fraternity, president of the Student Council, and a member of Quill and Dagger as well as Aleph Semach.

After graduating, Mr. Collyer joined the staff of the Bethlehem Shipbuilding Corp. where he served until 1923. At this time he was elected Vice-president of the Buffalo branch of the Dunlop Tire and Rubber Company. He went to England in 1930 as works director where he advanced to controller of manufacture in 1932. (We might add that Mr. Collyer still maintained his prowess at the oars by rowing a one man shell over the many waters of England.) Then in 1936 he became managing director and maintained this position until he joined the B. F. Goodrich Co. in 1939 as president. At this time Mr. Collyer was elected to the Rubber Manufacturers' Association in recognition of his knowledge of the rubber industry and its world wide ramifications.

Mr. Collyer was especially active in the development of the American synthetic rubber industry, realizing the need of America for another source of supply even before Pearl Harbor. He also served as special advisor to the State Department on world rubber problems during the war.

Last December Mr. Collyer received the "Medal for Merit" which is the highest award presented to a civilian by our government. He was the only man from the rubber industry to receive this award in recognition of his war-time contribution.

As a true and loyal Cornellian Mr. Collyer has served as director of the Cornell Alumni Corporation and the Athletic Survey Committee. He also represented Cornell as steward of the Intercollegiate Rowing Assoc., and has served as a Trustee of the university since his election in 1940.

Burdette Northrop, M.E. '19

Professor Burdette K. Northrop, M.E. '19, entered Cornell University as a sophomore from Stetson University in the fall of 1916. It is really rather odd that he entered Cornell, since he had come north from Florida with full intentions of studying either at Syracuse or Carnegie Tech. However, in passing through Ithaca with his parents to visit his birthplace at West Danby, he toured Cornell and has been associated with the University ever since.

Professor Northrop was an ardent student of both physics and electrical theory, and during his junior and senior years he was an instructor in these departments. Besides his work in instructing, Professor Northrop also found time to follow eagerly each development of the latest and greatest invention, the radio. He manuactured countless radio tubes, with the aid of homemade diffusion pumps in the basement of Franklin Hall, for the numerous improving circuits and sets which were rapidly being developed. He also assisted with an amateur radio station which was maintained here at Cornell during that time.

Besides that, Professor Northrop, being the oldest, had to maintain a watchful eye on his four brothers who had followed him and were all registered with him in Cornell at that time. It is also interesting to note that, as he, each of them became associated with various electrical engineering or physics departments throughout the country.

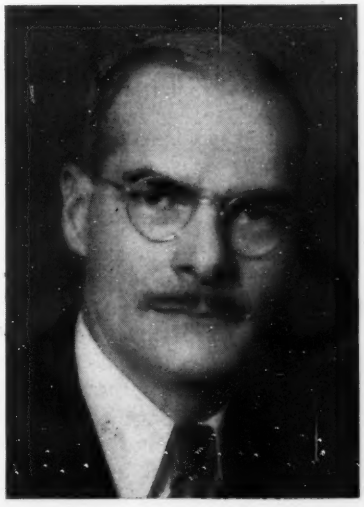
Then in 1923 Professor Northrop joined the staff at Colgate University and instructed there until he returned to Cornell in 1929.

For many years he and one of his brothers, who was now also associated with the College of Electrical Engineering maintained a joint office in Franklin Hall where mistaken identity was quite common.

Professor Northrop organized the popular electronics course and now serves as a class advisor. During the war he instructed extra radio courses.

Perhaps this brief profile will help you to understand why Professor Northrop is one of the most popular faculty members on the Hill.

Prof. Northrop



PROMINENT

Bob

Robert C. Beach, ME

Pick up the 1945-46 edition of the college students "Who's Who," and turn the pages until you come to the "B's": look down the list and you will come upon the name Beach, Robert C. His remarkable record speaks for him there. Now let us give a little personal history of Bob Beach.

Bob was born on Hallowe'en of 1922 in a small central New York town, Camillus, located about twenty minutes west of Syracuse. He attended Solvay High School and was active in athletics there. Golf was his greatest claim to fame and found him captain of the team in his senior year. Bob still strokes a mean ball and his drives really sizzle off the tees. He also took part in other activities in high school being a member of the Dramatic Club, Hi-Y and like every other red-blooded American boy, he was a member of the local Boy Scout Troop.

Upon graduation from high school in 1940, Bob momentarily put aside education and took a job in the interim. In February of 1942, Bob entered the Syracuse University extension school to study electronics. During this time, he picked up a hobby that few, shall we say, enjoy, that of motorcycling. Bob became very adept at handling his two-wheeled menace and also had an introduction into the functioning of the LAW. His work at the extension school was interrupted in November of '42 when he enlisted in the Navy. In April of 1943, he was graduated from the Naval Aerological school, Naval Air Station, Lakehurst, New Jersey, and was assigned to duty with the Navy Weather Central Commander South Pacific on that "lovely resort" island of New Caledonia. He received a superior efficiency rating and was recommended by his Commanding Officer for enrollment in the Naval College Training Program.

San Francisco, a brief stop at home, and on to Asbury Park, New Jersey for assignment to a college. Bob's choice of schools had been Cornell first and Hobart second, the latter of which he got.

During his first term at Hobart Bob pledged Theta Delta Chi and participated in basketball. In his second term he was recommended for a regimental position which he received. At the end of the second term, the name Beach had a familiar ring about campus, and it was no surprise to all when he was nominated to the Student Board of Control, elected recording secretary of Theta Delta Chi and appointed

(*Continued on page* 46)

Ed Lightfoot, ChemE

Ed hails originally from Wisconsin where he was brought up and received his secondary education. Becoming interested in chemical engineering, he was awarded a McMullen Regional Scholarship and entered the chemical engineering school here at Cornell in the summer of 1943. Of his early days as a chemical engineer not much need be said save that he showed promise of being a good engineer right from the start. However there is one incident which he will probably never forget nor will any of the fellows who knew him then: It was the usual dull afternoon in quant lab one day when Ed's voice broke the silence, announcing, as he held a 6″ glass cover-glass high in the air; "Look fellows, it's plastic." With this he sailed the cover glass across the lab where it came in contact with the wall and shattered into minutely fine bits of glass. His face has never been so red.

Shortly thereafter his family moved to Lakeland, Florida, where they now own a citrus grove. This move led Ed to become interested in fruits and their chemistry.

Besides having been on the Dean's list a number of times and being a member of A.I.Ch.E., Ed has spent the past two years squeezing a job as instructor of Mechanical Drawing into his tight and none too easy schedule. Just recently he was elected to the office of president (M.A.) of Alpha Chi Sigma fraternity.

In his spare time, if there is any, between his research and design work for Chem.E., his instructorship, and his job as M.A. of Alpha Chi Sigma, Ed enjoys playing around with a camera and is now undertaking to develop his own Ansco color films.

Ed will graduate this June and plans to return to Cornell this fall to get his Ph.D. in chemical engineering with an eye still turned toward the chemistry and engineering of fruit preservatives. When he finally leaves Cornell it is a certainty that one of the finest, most likeable fellows will not stop short of complete success in whatever field he chooses.

Ed

ENGINEERS

Jeanne Mount, CE

If you should come upon a pretty, dark-haired girl wandering around the halls of Lincoln, don't assume that she is sight-seeing or lost, for Lincoln has been Jeanne's home base since she entered Cornell in Civil Engineering four years ago.

Although born in Watertown, New York, twenty-one years ago, she has called Auburn her home town for most of her life. Jeanne attributes her early interest in Civil Engineering to the fact that her father, a claim investigator for the state, used to drag her along to inspect ditches, canal locks, new construction, and other fascinating projects; and to her contact with the state engineers who had their offices next door to that of her father.

In high school Jeanne was very interested in dramatics and did a lot of acting as well as serving as stage manager. She graduated from high school in 1943 as salutatorian of her class.

She came to Cornell with the New York State Cornell and Auburn College Club Scholarships. Her first year at Cornell, she was elected to the Civil Engineering Honor Committee, and since then has become a member of ASCE and helped to organize Pi Omicron, the women's honorary engineering fraternity. This year she is the chairman of the membership committee of the Independents' Council and recently received the highest number of votes in the IC elections; associate member of WVBR on the publicity committee; and a Circle delegate to the WSGA House of Representatives. She is also guilty of Bridgeomania, and may be seen frequently at the Straight during and between classes with other bridge fiends.

Among Jeanne's hobbies besides bridge are fencing (Jeanne attributes her success in this score to being left-handed) and horseback riding. When asked if she collected anything, she replied, "I collect people because you don't have to dust them or give them house room." Seriously though, Jeanne probably has a speaking acquaintance with as many people as anyone else on campus.

When Jeanne graduates this June she plans to do structural or soils work, preferably in Alaska. What a woman!

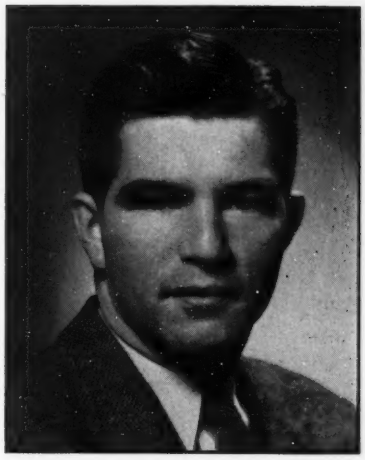
Jeanne

Charles H. Stanford, EE

Chuck Stanford is one of those New Englanders who think they speak the true English language and still can't be convinced that there is no "r" on the end of idea. That is only logical, however, because he was borne in Keene, New Hampshire and has spent most of his life in that state of old Dan'l Webster.

Chuck attended the massive high school in Troy, New Hampshire, with a total enrollment of 54 including the faculty and janitor. His graduating class numbered 10 but Chuck keeps a discreet silence about his standing in the class. During his summer vacations he served as a foot patrolman for the state of New Hampshire Forest Service. Apparently his services were appreciated, because after graduation he was employed as Forest Fire Watchman on Mount Monadnock.

Along with these outdoor traditions, Chuck has cultivated a taste for opera and symphony, and his Saturday and Sunday afternoons are usually spent glued to the super-het. That is, of course, when there is no Delta Club meeting on Saturday afternoon. Along with a love for poetry, especially Benet, he has acquired skill in poker and a phenomenal capacity for that amber liquid smacking of hops. These important qualifications along with that Finnish caution have caused Chuck to be elected as official "Keeper of the Beer Money" for the Delta Club.



Chuck

Anyhow to get back to the story, Chuck entered the University of New Hampshire and after a year of Engineering there enlisted in the Marine Corps. He was assigned to the V-12 corps here at Cornell and enrolled in the School of Electrical Engineering. After about five terms of that, he was transferred to Paris Island. From there he was transferred to Camp Lejeune and received a commission the day he was released from service in the fall of 1945. He worked in a machine shop in Keene until the spring term of 1946. Right now Chuck is slated for graduation in June with a degree of Bachelor of Electrical Engineering in the Communication Option. Along with his other work, Chuck is now Chairman of the AIEE (student branch) and is trying to whip up a program for this term. This term, for the first time, he was allowed an elective, so he immediately enrolled in a course in New York State folklore. "What a change," Chuck crows, "230 coeds and only 20 guys." "We even sing folk ballads in that class, 249 voices in unison and Stanford's."

Recent Developments In Engineering

Techni-Briefs

Navigation

The astrocompass appears to offer great possibilities for the determination of direction in polar regions according to Gordon A. Atwater, chairman and curator of the Hayden Planetarium in New York. The astrocompass uses the sun and stars as reference points and from them determines directions on the earth. To date the arctic and antarctic regions have not been accurately mapped (as Admiral Byrd found out), and this new instrument should prove more accurate than the magnetic and gyro compasses. The exact behavior of radar and loran in the polar regions may soon be determined.

Aircraft Safety

General Electric has developed an automatic flight recorder which will be used in the study of aircraft accidents. The recorder will not only furnish data which may later determine the cause of an accident, but will also detect dangerous airplane or pilot tendencies before they lead to accidents.

Weather In General

Dr. V. K. Zworykin, RCA Scientist, reveals that hurricanes may be stopped, fog dispelled, and rain precipitated as results of calculations to be made possible with an electrical instrument now in early stages of development. The new instrument will indicate not only weather conditions for the future, but will also indicate the causes and origins of the weather and will point out where man-controlled energy may best be applied to control the weather in the most economical way. It may not be too far off before man can either dissipate hurricanes at their source, or deflect them in such a way that they wear themselves out with a minimum of damage to society.

Russia:

The Soviet bought $125,000 worth of technical books from all American publishers last year.

The first of three 90,000 kva generators, installed in the famed Dnieper Dam in South Ukraine has been run successfully at full speed. This is the first power operation of the dam since the Red Army dynamited the original generators to deny their use to the Nazis in 1941.

Electricity and Electronics

A 500-kv power transmission test line has been planned to be built in Ohio. Investigations will be centered around corona loss, radio interference, and insulation coordination at high voltages. Many companies are participating in the experiment.

Petroleum Scientists of the Standard Oil Company (Bahamas) are using modern methods, including radar, in a search for possible oil reserves under the ocean. Use of radar permits the geophyscists to plot the site of all tests with improved accuracy. Radar targets 50 feet high are set up at strategic points in the exploration areas, enabling the navigator aboard the equipment boat to pick them up on his radar screen.

Invisible Light

Infra-red photographs are now taking their place beside the X-ray to detect forgeries or prove the authenticity of paintings of the old masters. Murray Pease, associate currator of the Metropolitan Museum of Art said that the infra-red rays pass through the outer layers of paint making it possible to investigate the layers of a painting below the surface. These lower layers are usually the most characteristic of the old masters.

Magnetic Mapping

Dr. Louis B. Slichter, professor of geophysics at the University of Wisconsin, says that of all the developments in wartime research, the flying magnetometer is the most useful in mining prospecting. "Magnetic mapping from airplanes can serve to distinguish areas having no prospects for ore, and to reveal geological conditions which are known to be favorable."

It is hoped that the airplane and the magnetometer will be able to give us a complete map of the terrestrial magnetic field from pole to pole. A satisfactory explanation of the causes of the earth's magnetic field may also result.

Synthetics and Plastics

Women's stockings made of synthetic yarns will eventually be varied to meet almost any demand in styles and sectional fads according to DuPont. This is no yarn.

Standard Oil Company (New Jersey) reports that new products resulting from research and development in the petroleum industry are: synthetic soaps of superior quality; a type of resin that can be made into thin sheets and wrapped around perishable food products; cheaper but highly effective fungicides and insecticides; a synthetic gasoline from natural gas that already appears to be competitive with gasoline produced from petroleum.

Stokes and Smith Company, Philadelphia, have developed a machine that can pack 40 or more frozen food transparent bags in a minute.

Miscellany:

The Mexicans are saving time and money by pouring concrete slabs from the top floor to the bot-

(*Continued on page* 48)

Sparks of Welding Progress

A General Electric worker butt-flash welding a rotor ring for a huge generator.

—Courtesy G.E.

Out of Phase

By HERBERT F. SPIRER, EP '51

One chilly night last week, while I was peacefully reading the second volume of *War and Peace* at Jim's, a kindly old drunk beckoned to me from his hideout under the table. He claimed that he had a hot tip, so I brushed aside my posset (Shakespearian Mickey Finn), and propped the old reprobate against the juke box. Two Ithaca College flappers dropped nickels into his mouth and he began to talk.

It seems that the old duffer had been sniping butts in Olin and overheard this story in the drawing room. A certain Miss L - - wanted to take ChemE at Cornell but was forced to go into the Arts School as a Chem major, because the powers that be decided they had a sufficiency of female pharmacists.

Not the type to sit back and brood, she went out and found a ChemE who agreed to switch courses with her. Headquarters approved of the arrangement and soon after Miss L - - reported to Dusty for the Inquisition. Dusty pored over her record, shook his head with approval and queried,

"Do you drink beer?"

"Why, no.", replied the bewildered little gal.

"Well, all the ChemE's have to participate in the weekly beer parties; so you better learn to drink beer and get plenty of practice!"

His story told, the old boy returned to the floor, and I spent the rest of the evening hunting for a female pharmacist taking "Father" Rhodes' advice . . . She must have been practicing at the Dutch that night.

* * *

I once had a classmate named
Jessar,
Whose knowledge grew lesser and
lesser
It at last grew so small
He knew nothing at all,
And now he is an Arts School professor.

How do you rate around Sibley? Are you hep to the integral? See where you fit into modern engineering society:

1). A device for making your answer agree with the answer in the back of the book is, (a) Zinck's lower deck, (b) Benzedrine, (c) Sc, the Sibley Constant.

2). This is easy: the ratio of prelims failed to prelims taken may become higher because of: (a) bad eyesight, (b) overabundance of proctors, (c) illegible crib notes.

3). The ambient temperature of Rockefeller A when you are fifteen minutes late for Prof. Grantham's Lecture is: (a) colder than a witch's icebox, (b) room temperature, (c) above recrystallization temperature.

4). The number of female engineers at Cornell is; (a) not enough, (b) 29, (c) too many.

The answers are given below. Check your answers against the correct answers; give yourself six points for each correct answer. Subtract the mark you got on your last Materials Prelim. Multiply by the number of eight o'clocks you have this term. Put the result in the bathtub, add sugar, allow the mash to ferment and distill when ripe. Add hydrogen for flavor.

* * *

Answers:

1). (c), also equal to Ff, the finagle factor, accurate to 85 significant figures.

2). (a), (b), and (c). "Ask the man who flunks one."

3). (a) or (b), depending on the individual. Save wear and tear on the nerves by arriving early or not at all.

4.) (b). First it was the cigarette, then the vote, and now Engineering. What next, little woman?

* * *

The Rod and Snowshoe

The monthly meeting of the Rod and Snowshoe Traversing Society was held last weekend in the Snake Room of the Seneca Hotel. Memorial services were held for George Barbleman Splotzkipedus III, a former legacy in the CE school. Mr. S. was lost during the spring thaw while out on a field problem. He accidentally stepped into a mud puddle behind White and disappeared from sight in twenty seconds.

The guest speaker, Professor Winter, who was to speak on "That Russian Winter," was unable to appear. Instead, the group translated Breed and Hosmer into Sanskrit.

The Society also voted to establish a scholarship to be given only to students unable to maintain a 72 average. The scholarship shall consist of the income from a two dollar bet on Leaping Moose to place in the Fifth at Pimlico. The meeting adjourned Monday morning by unanimous consent of both surviving members.

* * *

Then there was the CE who thought a polymer was a man who had three or more wives . . .

* * *

Pendulums, etc.

The most fascinating experiment that Professor Grantham performs during his lectures is performed at considerable risk to himself. I refer, of course, to the demonstration with the long pendulum, where Professor Grantham braces himself against the blackboard, with the same devil-may-take-me attitude the condemned man assumes when he stands before the firing squad without blindfold or cigarette, and holds the ball of the pendulum to his uplifted chin. He then lets go of the ball, the pendulum swings out over the heads of the tense students, sweeps back through the air with a menacing swish, stops dead a hair before our hero's chin, and drops down into the waiting arms of Mr. Maret. Professor Grantham walks away unscathed, and the class draws a sigh of relief.

(*Continued on page* 48)

NEW BOOKS FOR ENGINEERS

AIRCRAFT CARBURETION. By Robert H. Thorner. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1946. Cloth, 5½ x 8½ in., 393 pp., illus., diagrams, charts, tables, $3.50.

This book is the compilation of a series of lectures given by the author for a course in aircraft carburetion in connection with the Engineering, Science, and Management Defense Training program. It is designed for use by aircraft mechanics, flight engineers, and students taking a course in aircraft engines, and it deals mainly with the fundamental operating principles of carburetors.

The physical laws governing pressure, pressure measurements, and fluid flow are first discused with a minimum of theory, and with the aid of simplified and comprehensive diagrams. The general outline of the carburetor systems usually employed to maintain the desirable engine operating characteristics; namely, the main metering system, the idling system, the acceleration system, the power enrichment system, and the mixture control system are presented in the conventional manner and discussed in some detail. Methods of incorporating these basic requirements into commercial types of aircraft carburetors occupy the major portion of the book. Typical modern carburetors of the float, diaphragm and injection type are thoroughly covered in the written explanation, and visually clarified with the aid of sectional illustrations, and schematic diagrams. The operation of the fuel pump and supercharger, and their relation to the carburetor are discussed, and finally a brief coverage of carburetor testing, and carburetor performance in flight operation is given.

Field Service

As a collection of manufacturer's data this book seems to best suit the needs of a field service engineer for airplane engines. A section on carburetor maintenance and trouble shooting would have enhanced its value to the aircraft mechanic. For the college student, the scope of the book, and the method of treatment of the subject matter are too limited to make it useful as a text, although it might conveniently serve as a source of reference in a course on aircraft engines. In this respect, the charts and graphs in the book would be more helpful had numerical values been assigned to the coordinates rather than the words "high" and "low", or "rich" and "lean".

Norman R. Gay
Asst. Prof. Heat-Power Eng.

ELEMENTARY HEAT POWER. By. H. L. Solberg, O. C. Cromer, and A. R. Spalding. John Wiley & Sons, Inc., New York, N. Y.; 480 pp. 6 x 8½, $4.75.

The primary purpose of this text, as stated by the authors in its preface, is to enable students to develop an understanding of the functions and performance of heat-power apparatus as a basis for a more intelligent and purposeful study of thermodynamics. Secondary objectives are to offer material for a terminal course for those students not studying thermodynamics, and to provide a background for laboratory testing of heat-power equipment.

Books Reviewed in this Issue:
Aircraft Carburetion
Elementary Heat Power
Principles of Radar

The authors consider such fundamental subjects as matter, energy, fuels, and conbustion, without specifically considering thermodynamics. These fundamentals are then applied to all of the usual applications in heat-power engineering, including internal combustion engines, steam power plants, gas turbines, and refrigeration apparatus. Most of this material is descriptive and the manner of presentation is very similar to other texts on these subjects. The figures and photographs are particularly good and should prove to be very helpful, especially in schools where a lack of laboratory apparatus is a major handicap. Although an attempt has been made to cover the principal types and designs on any given subject, there seem to be a number of important omissions. Under fuel injection systems for compression ignition engine, for example, most engineers will be surprised to find that the Bosch fuel system and the General Motors unit injector have been omitted, whereas other fuel systems that are less representative have been included.

Omissions

To write a text book on heat-power engineering without discussing thermodynamics, is indeed difficult. It is obvious from this text, that the authors have encountered this difficulty. They have carefully defined work and heat as forms of energy in transition, have included the first law of thermodynamics, and defined enthalpy. They have omitted the second law, the concept of reversibility, and entropy. The difficulties arising from these omissions are noticeable. The pressure-volume diagrams are given but, of course, temperature-entropy diagrams cannot be. Instead, the temperature-enthalpy diagram is used. Under internal combustion engines, the efficiency of the Otto cycle is stated as being e=1—1/rx—1. This, of course, cannot be justified without thermodynamics. The treatments of efficiencies in general is not very satisfactory, nor could it be without the basis for calculating the performance of the corresponding ideal prime movers.

Within the limits imposed by the omission of most of thermodynamics, the authors have done a credit-

(*Continued on page* 46)

Cornell Society of Engineers

107 EAST 48TH STREET 1946-1947 NEW YORK 17, N. Y.

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CARL F. OSTERGREN, *Executive Vice-President* 20 Rockwood Road West, Plandome, N. Y.

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KARL J. NELSON, *Vice-President* ..... 112 Orange Ave., Cranford, N. J.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

Mr. Creed Fulton

President's Message

You see above the picture of Creed Fulton, a vice president of the Society, for, after having visited one of the Society meetings that he put on at Philadelphia recently, I feel he deserves the place of honor for the splendid work that he and his associates have done in organizing this strong group.

The particular night I was there we had an address by James Lincoln, president of the Lincoln Electric Company of Cleveland. Naturally, one who has done such an outstanding job in employer-employee relations during these troubled times packed the dining room at the University Club with those who wished to hear what he had to say.

His message as to how, starting with a bonus system for a single foreman, he has worked the entire organization into an effective team of profit-sharing individuals, was an inspiring one. I think a great deal of Lincoln's success is due to his recognition of the fact that those who work by their hands can be made to take a greater pride and interest in their work when Management has learned to look upon them and treat them the same way as we would an artist or a musician who uses his hands to express his chosen talents.

Mr. Lincoln stressed several times the chief problem is to create conditions under which the man works that will make him think of his job as something he LIKES to do and not just as something he MUST do for a living.

In addition to a liberal bonus plan which has now increased the average wage of all employees to around $5,000 a year, liberal awards are made for good suggestions. Rather than the token amount as many companies give, they have paid out over $1000 on a single suggestion. Naturally, as a result of all these inducements, they have a long waiting list of those who would like to join the company.

The question and answer period which went on for about one hour afterwards was indeed stimulating. It was enlightening to learn that while wages of employees have gone up steadily, the cost of making products has decreased so that, for instance, a 200-ampere welding machine that sold for $600 in 1932 sold for only $200 in 1945, and the total annual output per worker increased from $10,000 in 1932 to $26,000 in 1944, whereas the average output for competitors in 1945 was only $12,000.

I was interested in some of the innovations which Creed has put into the Philadelphia group: while assembling for dinner, recordings of a number of the popular Cornell songs and Glee Club renditions were played. Another point that interested me was the presence of prominent Philadelphia engineers from other colleges, not even forgetting our rival Pennsylvania.

Creed, who graduated with an M.E. in 1909, has been continuously active in Alumni affairs since then, having founded the Cornell Club of Seneca County in 1912 and having been first secretary then president of the Cornell Club of New England for several years in the early '20s. But perhaps his most outstanding work was as president of the Alumni Association from 1938 to 1942.

Since this was the first area to have their own engineering meetings, I was naturally very happy to visit it and to learn how successfully it is operating.

In the next issue I will be able to report on meetings we expect to hold in two western cities in the hopes of establishing sections there.

ROBERT B. LEA

Alumni News

Lewis C. Cerry, Jr. B.Chem.E. '15 is Far Eastern manager for National Aniline & Chemical Co. in Shanghai, China.

Frederic E. Lyford M.E. '16 has been elected president of Merritt, Chapman, and Scott Corp. of New York City.

Recent report from **Donald H. Parce M.E. '09** show him to be still engaged in a "clean" business—he's the owner of a laundry and a dry cleaning plant out in Berkeley, California. Interested in civic affairs, he has served as a member of the Berkeley city council for the last six years. Back in 1909 he stroked on the crew and helped start the local chapter of Phi Kappa Sigma. His daughter, Martha, a student in home economics is now a loyal Cornellian also.

William E. Kennedy, M.E. '10, is assistant publisher of American Machinist and Product Engineering, McGraw-Hill publications.

James T. Burton, C.E. '14, has resigned from Healy Petroleum Co. and has formed his own producing company.

Alester G. Holmes, M.E. '29, is professor of mechanical engineering at Mississippi State College in Stackville.

Jean T. Mitchell, M.E. '35, is a development engineer with the Chamberlain Corp., Waterloo, Iowa. Discharged from the Army in November, 1945, he spent four and a half years as Ordnance Officer in charge of production of all armor-piercing ammunition.

William T. Fine, M.E. '40, of Hoosick Road, Troy, has just opened his own factory for the manufacture of truck bodies and trailers.

J. Robert Meachem, E.E. '41, has been granted a construction permit by the Federal Communications Commission for a 250-watt AM station on 1450 kilocycles to operate at Elmira. At Cornell, he was president of the Radio Guild for two years, initiating the wired radio system CRG, now WVBR. He belonged to Eta Kappa Nu, Tau Beta Pi, and Quill and Dagger. After graduation, he spent a year with Lockheed Aircraft Corp., Burbank, California, then became a civilian radar engineer with the Navy Department, Bureau of Ships, Washington, D. C.

Walter A. H. Granty, C.E. '20, is president of Frederick Snare Peruana, S. A., of Lima, Peru, consulting engineers and constructors, a subsidiary of Frederick Snare Corp.

Robert E. Roesch, E.E. '22, is an application engineer with International General Electric Co., Schenectady. He has been released from active duty as colonel, Army Signal Corps, after five years of service, half of which was spent overseas in the China-Burma-India Theatre of Operations.

Julius F. Siegel, E.E. '30, is chief product engineer for Super Electric Products Corp., Jersey City, N. J.

Grant C. Ehrlich, B.S. in A.E. '38, is president of Resin Industries, manufacturers of electrical insulating materials from synthetic resins. The company is just ending its second year of successful operation.

William T. Cole, B.S. in A.E. '40, is assistant to the president of Canton (Ohio) Malleable Iron Co. He was discharged as a lieutenant commander, USNR, after almost five years of duty.

Frederick Fahnoe, Chem.E. '41, joined General Aniline and Film Corp., Easton, Pa., in March as a chemical engineer and assistant to the head of the engineering department.

James E. Kiester, E.E. '35, and **Robert S. Thurston, E.E. '29,** were recently appointed to act as General Electric's alumni representatives to Cornell. The men are resopnsible for development work here at Cornell and for interviewing prospective G.E. employees among the graduating engineers. Mr. Kiester is also section leader of the Television Engineering Section, Transmitter Division, of the General Electric branch in Syracuse while Mr. Thurston has done the greater part of his work with air conditioning.

John Gnaedinger C.E. '46 is now employed with the C. A. Metz Engineering Company of Chicago as structural engineer. Mr. Gnaedinger receives his Master's from Northwestern in June.

Henry E. Van Derhoef M.E. '01 of Rochester has formally retired from the Eastman Kodak Co.

Albert L. Dittmar C.E. '19 is now chief right of way engineer for the Pennsylvania State Department of Highways with offices in Harrisburg, Pa.

Robert C. Kennedy C.E. '21, assistant chief engineer of the Eastbay Utilities District in Oakland, California has been elected president of the American Water Works Assoc.

Walker L. Cisler M.E. '22, formerly of the U. S. Corps of Engineers has received the Legion of Merit for his work in restoring damaged utilities in the European Theatre. He has now returned to the Detroit Edison Co. of Detroit, Mich.

Robert R. Bridgman M.E. '25 is a plant engineer with the Sterling Engine Co. of Buffalo, N. Y.

Harry F. Hartman C.E. '26 is head of the engineering division of the Humble Oil Co. refinery in Baytown, Texas.

John S. Walter E.E. '33 has returned to his position with the Standard Oil Company after six and one-half years service with the U.S. Signal Corps.

Kenneth E. Turner, Jr. M.E. '40 is now a transportation engineer for the truck and coach division of General Motors in Pittsburgh, Pa.

Kenneth A. Kesselring E.E. '41 has returned to his position with the General Electric Co. as head of a section of the Atomic Power Project.

Kenneth L. Rebman B.M.E. '42 is now employed with the Stanolind Oil and Gas Co. of Woodsboro, Texas.

Donald L. Johnson B.E.E. '43 is with the planning department of General Electric's electronics plant in Syracuse.

Accident Prevention

(*Continued from page* 15)

jammed material without putting his hand under the die. The worker, however, removed the guard and counterweighted his foot pedal until he achieved a hair-trigger effect. When a punching jammed, he attempted to remove it with his bare hand, inadvertantly tripped the pedal, and the punch came down through his hand. In this case the employer had provided adequate safety facilities, but had, in some way, fallen down in his duty to see that the employee performed safely. Management, nowadays, must not only concentrate upon the problem of instructing workers in the safe way to do the job, but must also make the worker safety-conscious.

Accident Proneness

To secure the maximum in safety it is necessary to think about accidents even before hiring new men. When applicants came into a certain factory, it was found that they fell into the following categories: 3% undesirable as workers; 12% somewhat inferior but who can be made useful in some jobs; 70% normal individuals; 10% above normal; and 5% leaders. Although these figures might not apply exactly to any other business, it can be expected that figures very similar to those would be found in other places. Although there is no exact correlation, it has been found that the lower 15% in intelligence is more prone to accidents than the more intelligent group. In this factory, the lower 3% of the applicants could not be used in any job, and the next 12% could be placed only in jobs that required little effort on the part of the worker to stay away from injury. This accident proneness, as it is called, has also been found to be caused by other factors than subnormal intelligence. To secure the maximum freedom from accidents, it is desirable to screen the accident prone persons from the applicants before they are hired. Various tests have been used for this purpose including tests of reaction time and coordination, visual characteristics, distractibility and reaction in an emergency, and intelligence. Although all of these tests can help to some extent to weed out the accident prone persons, knowledge of the causes of accident proneness, is, at present, very sketchy and much more research is needed on this subject before it will be possible, if ever, to distinguish positively except by trial which person is prone to accidents.

Safety on Highways

Another field where a scientific study of accident prevention is necessary discussed in

The May Issue of the CORNELL ENGINEER.

Job Training

After a new worker is hired, it is best to teach him the safe way to do his job before he forms dangerous habits that are hard to unlearn. A step in this direction was the introduction of "Job Instruction Training", sponsored by the War Manpower Commission. J.I.T. is a breakdown of each job into the important steps and key points. (See Figure 2.) A key point is located at any place in the operation where accidents are likely to occur. With the knowledge of the danger points and the safest way in avoiding an accident at this point, the worker starts the job with a better chance of escaping injury.

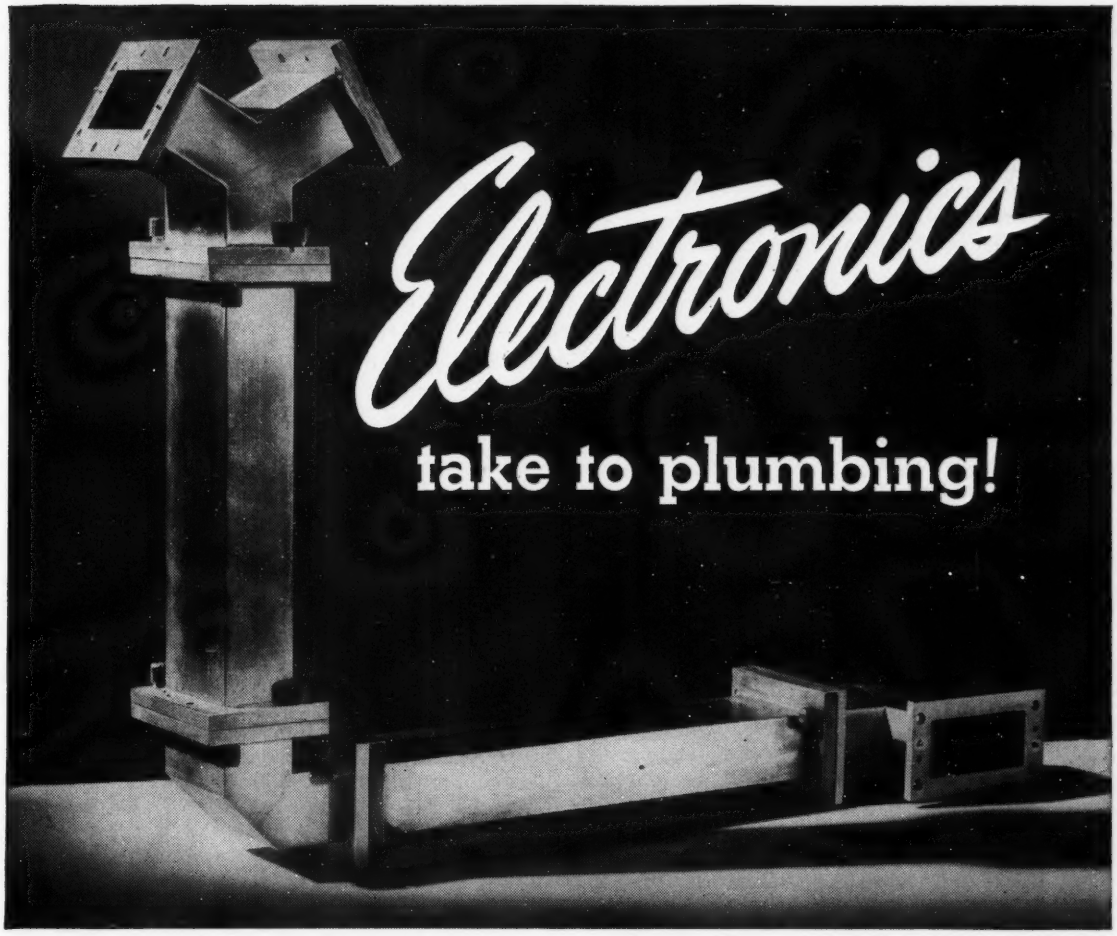
Mere knowledge by the worker of the reasons for accidents will not stop accidents. The worker and management must become accident conscious and at all times try to do things the safe way. The foreman is the key man in the achievement of this aim. Since he is directly in charge of the workers, he is best able to see in what manner and why the individual falls down, and he can apply safety psychology. Often it is necessary to know the worker personally before the cause of the accident can be determined. Seemingly unrelated events can affect the attitude or general behavior of the worker. Such intangible things as an unhappy homelife, emotional immaturity, or uncooperativeness can cause accidents.

It has been found that every normal worker has certain motivating qualities which, if properly appealed to, will cause the worker to be a better safety risk. Some of the more important of these characteristics are: self-preservation, per-

(*Continued on page* 28)

Helpful, instructive classes in safety are necessary if accidents are to be cut to a minimum.

—Courtesy Westinghouse



HERE'S a new kind of pipe. It carries microwaves. It began to take shape in college.

A student was experimenting with the transmission of very short radio waves over wires immersed in a trough of water. The waves travelled along the wires as expected, but then he discovered a second set of waves in the trough—a set dependent not on the wires, but *guided* by the trough itself.

Several years later this student, then a scientist at the Bell Telephone Laboratories, became interested in the transmission of microwaves. He recalled his college experiment. Could a metal sheath be substituted for the trough? Would such a pipe line carry high frequency radio waves with greater efficiency than an ordinary line?

It could and it would: but the wave lengths available required pipe lines that were too bulky to be practical. Electron tubes were soon developed which generated shorter waves . . . waves which made it possible to use pipe lines of smaller, more manageable size. These pipe lines, known as waveguides, proved indispensable to radar in war. Now, with the invention of accessories to serve as coils and capacitors of wire circuits, waveguides are becoming an even more important part of our radio telephone and television systems.

Such men as this young scientist whose keen minds can recall early observations and apply them intelligently to new problems will find telephony a fascinating and a rewarding career.

There's Opportunity and Adventure in Telephony

BELL TELEPHONE SYSTEM

Accident Prevention

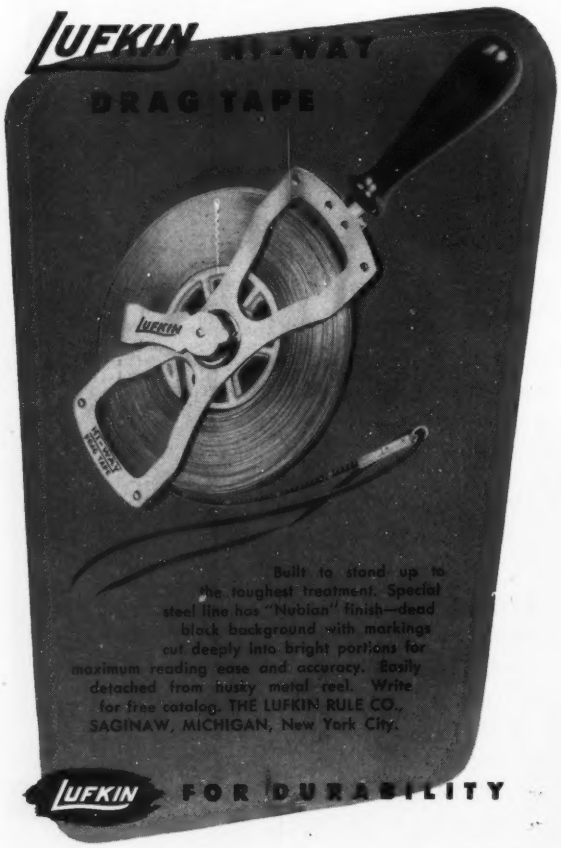
(*Continued from page 26*)

sonal gain, leadership (desire to be outstanding), conformity (fear of being thought different from others), and humanity. Any program to promote safety should appeal to the more predominant of these traits in such a way as to promote safety. Since these traits are of different degrees of prominence in different people, it is impossible that any safety plan will have the same effect on any two people. Some people when subjected to ridicule will react favorably, while others will react in just the opposite way. Since the foreman is the only supervisory official who can know each man well enough to realize which type of psychology to use, it is evident that the foreman is the key man in the safety program. In addition to this, the workers tend to reflect the attitude of their foreman. It is essential, then, to a good safety program that the foreman be both accident-conscious and an amateur psychologist.

Summary

Management has decided by a large majority that accident prevention pays dividends. Over a period of years manufacturers have estimated returns of from a dollar and a quarter up for every dollar invested in accident prevention. Therefore management is pouring more money every year into the development of accident prevention programs; hence safety measures are becoming more scientific. We have found that there are two basic causes for accidents; (1) the unsafe act of a person and (2) the mechanical or physical hazard. Usually it is fairly easy to diagnose the real hazard from the accident report and to correct it; but the unsafe act of people is not so easy to remedy. To do this we try to sift out those who are accident prone before hiring, hold job training courses, and train the foreman to diagnose the individual problems of his men and to try to correct them individually.

Although it is evident that large advances have been made in accident prevention study during its fifty-year history, there is still much to be learned. For example, we know very little about the subject of accident proneness. Perhaps sometime in the future we will be able to reduce accidents to the vanishing point, but that time is still a long way off.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CHEMICAL COMMENTS

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Take a plastic—to be specific, take Dow polystyrene—air-expand it until it honeycombs into a rigid material that is even lighter than cork—and you have Styrofoam. It's winning new laurels in the low temperature insulation field because of its high efficiency, extremely light weight, good strength and excellent stability. This is the same Styrofoam used to advantage in boats and canoes, life rafts, beach toys and novelties. It floats, and *stays* afloat, because its millions of tiny air cells are individually sealed.

Caustic Comment: *Did you know that caustic soda—one of man's most widely used and sorely needed chemicals—is the pickling ingredient that takes the bitterness out of green olives?*

New Washable Plastic Paints

The wearable, washable characteristics of plastics are now given to new plastic paints. A tough protective film is formed by plastic particles that bond themselves together. The paint, made possible by a new product called Saran F-122 Latex, dries extremely fast into a long-enduring glossy finish. These paints may be applied with either brush or spray to wood, fibreboard, metal or masonry.

Whiffs and Puffs

Many a favored brand of pipe tobacco is being forsaken for the new tobacco mixtures with a tantalizing blend of maple-licorice plus a definite suggestion of walnut. Secret of the new flavor fillip is the Dow aromatic specialty, Cyclotene . . . one of many man-made aromatics bringing forth new scents and tastes in soaps, cosmetics, flavors and perfumes.

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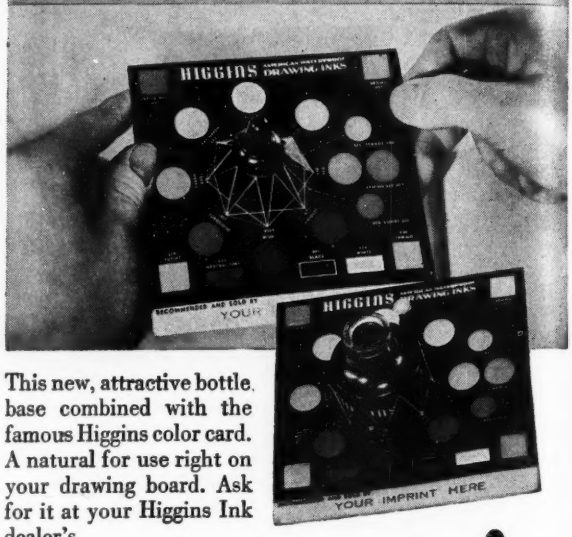

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Next Step—Space

(*Continued from page* 9)

path. It will then continue away from the Earth as the gravitational force reduces its velocity, and when it reaches the apogee of its orbit it will have a velocity equal to zero and will start to fall back towards the Earth, once again in the form of an ellipse, but this time with slightly smaller minor and major diameters. When the ship returns to its perigee, which is that point in the orbit which is nearest to the Earth, its velocity will once again be decreased and will repeat its flight into space. The fourth and fifth grazing will most likely suffice to reduce the velocity enough so that the use of the aforementioned reverse rockets would permit it to land.

The apparent simplicity and practicability is disturbed by several technical factors of great import:

The first of these and probably the most important is that of heat transfer and temperature change. In order sufficiently to heat the air as it passes through the athodyd it is necessary to slow the air down to a subsonic velocity. This enormous decrease in velocity that occurs when the ramjet is traveling at velocities beyond a mile a second are such that an increase in temperature of great magnitude naturally occurs. This change in temperature might suffice to reject the theory on the basis that no materials to resist such temperatures are available. However, it must be considered that with each rise of one degree Centigrade, sonic velocity increases approximately two feet per second. This means that the air will not have to be slowed down quite as much in order to heat it up at this new, higher sonic velocity. However, if the air does not have to be slowed down as much, the temperature will not rise as originally planned, and, in due time, an equilibrium will be reached. A great factor in the design of the space ship would be this equilibrium temperature.

"Rockets and Jets" by H. Zim

Figure 4. Braking ellipses as they would be used in effecting a landing on a planet.

The second factor that has to be considered is that of friction. The flight of the ship as it picks up speed in preparing to leave the Earth must be so planned that its increase in altitude would be a function of the air density. This must be plotted so that as the

(*Continued on page* 32)

This message originally appeared in the Trenton (New Jersey) Times Advertiser.

WHAT DO YOU SEE IN YOUR NEIGHBOR?

TRENTON BY ORIGIN is a crossroads—a community of people drawn together from the four corners of the earth by any one of a number of attractions.

Being a part of this growing neighborhood is a responsibility, for its interests are your interests—its friends, your friends—its enemies, your enemies.

There was a time when cities like Trenton were protected against attack by great walls and strong gates. Today's assailants cannot be kept out by such primitive methods. They come into our midst like invisible Trojan horses, and their only weapons are theories and glib tongues.

Disguised as friends, they reveal themselves only after they have assembled enough followers to attack from within; when it is too late for us to do anything about it.

Their methods are simple: They work with us, agree with our ideals, and sympathize with our troubles. When they have won our confidence, when they have succeeded in getting themselves appointed to committees, and elected to offices...they turn upon us. Like the amiable tourists, who suddenly donned enemy uniforms, during the last war, they attack when we least expect it...when we are helpless against them. They usually begin by labeling our time-tried leaders with names which insure their downfall—but which describe the intruders best—and having succeeded in ousting our leaders, they take over.

Is it too late to do what stone walls and strong gates could not do? Do we want these dangerous men in our country, in our clubs, in our unions, in our businesses and in our government?

Let the man who wants to hold office identify himself. Let the man who wants to live with us and work with us, reveal his purpose. Let the man who wants to have a voice in our affairs, disclose his ambitions and ideals.

It is our duty to know our neighbors. We only can trust them when we do. "Good fences make good neighbors" and good neighbors make good cities—good governments —good unions—good businesses—good citizens.

JOHN A. ROEBLING'S SONS COMPANY
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Next Step—Space

(*Continued from page* 30)

ship's velocity increases its altitude change brings it to a strata of air not dense enough to permit friction to destroy it but still dense enough to permit running of the athodyd.

Other problems include such important things as: designing the space craft so that it can pass through the trans-sonic range safely, obtaining materials to resist the high combustion chamber temperature, storing the enormous amounts of fuel required to run the rockets, and developing equipment for the space explorers to wear and use in the absence of an atmosphere and normal gravitational effects.

Whether or not the atomic powered athodyd can provide the solution to space flight, time, and time alone, will tell. This much can be said, however; no matter if it be by using the ramjet or if it be by total rocket propulsion, the youth of today shall see a flight from the Earth in their life span.

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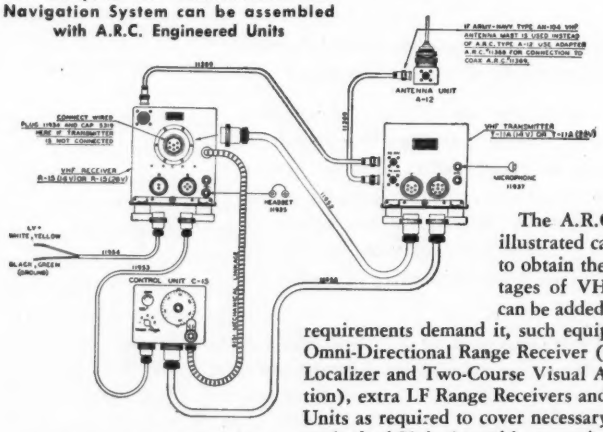
Your Complete VHF Communication and Navigation System can be assembled with A.R.C. Engineered Units



GOOD DESIGN TAKES TIME

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The A.R.C. Type 17 System illustrated can be installed now to obtain the immediate advantages of VHF. To this system can be added, when operational requirements demand it, such equipment as the VHF Omni-Directional Range Receiver (with provision for Localizer and Two-Course Visual Aural Range operation), extra LF Range Receivers and VHF Transmitter Units as required to cover necessary frequencies. This method of Unit Assembly was pioneered by A.R.C., and provides a flexible installation, quickly removable for maintenance and adaptable to individual operational needs.

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Aircraft Radio Corporation
Boonton, N. J.
DEPENDABLE COMMUNICATION AND NAVIGATION EQUIPMENT

Engineer-Scientist

(*Continued from page* 11)

separated the research man from the engineer is rapidly closing. There is greater need for a convergence in the training of both groups. This the war demonstrated dramatically, when large numbers of physicists and chemists were called upon to abandon pure research and devote themselves to problems of engineering development, to working out the practical consequences of prewar research which they alone were in a position to pursue. Engineers were at the same time confronted with engineering and production problems in novel fields, such as radar and atomic energy, that the research man had just opened up. In many important war projects research and engineering were carried on almost concurrently to insure the maximum coordination and speed. There is no reason to feel that techniques developed under the stress of war will be wholly abandoned in peacetime. With the physicist centering his attention on massive and complex equipment for the production of high velocity subatomic particles—the cyclotron, betatron, etc—he will encounter innumerable engineering problems. At the same time new problems are making increasing demands upon the mathematical and scientific preparation of the engineer. This is one of the reasons why engineering education is at present undergoing a drastic overhauling.

The closer association of research and engineering will of course include a steady expansion of engineering research and is already leaving its mark upon the course of pure scientific research. It is sure to do so increasingly in the future; for practical considerations are more and more likely to direct the attention of the pure scientist to unsolved problems whose answers are of great potential utility. This raises the interesting question of the extent to which such practical considerations have already influenced the course of the history of science. Put in another way, the question reads: what part has the engineer played in the history of

(*Continued on page* 34)

Du Pont *Digest*

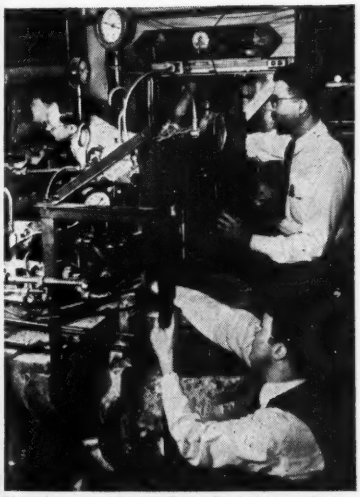
Items of Interest to Students of Science and Engineering

Research Problems in the Manufacture of Nylon

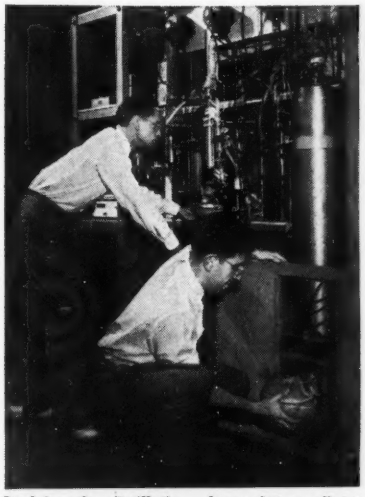
Last month in this space the development of nylon was traced from a fundamental research study on linear polymers to the first synthetic organic fibers, the superpolyamides. This installment deals with the complex manufacturing research problems that followed.

From the start there were obstacles to the production on a commercial scale of the "66" polymer—so named because the adipic acid and hexamethylenediamine from which it is made have six carbon atoms each.

Although adipic acid was being produced in Germany, it was necessary to develop a new process to meet conditions at Du Pont's Belle, W.Va., plant, where, because of the catalytic technique involved, it was decided to make this intermediate. Hexamethylenediamine was only a laboratory curiosity, and a process for its commercial production had likewise to be worked out. Fortunately it was found that the diamine could be made from adipic acid by new catalytic processes. The results of these investigations may be summarized as follows:



Charging experimental condensation polymers to a spinning machine for evaluation: O. C. Wetmore, Ph.D. Organic Chemistry, New York University '44; D. A. Smith, B.S. Mechanical Engineering, Purdue '40; C. O. King, Sc.D. Chemical Engineering, Michigan '43.



Studying the distillation of new intermediates for condensation polymers: T. J. Dickerson, B. S. Mechanical Engineering, Virginia '43 and E. E. Magat, Ph.D. Organic Chemistry, M.I.T. '45.

$$C_6H_6 \xrightarrow{H_2} C_6H_{12} \xrightarrow{O_2} (CH_2)_4(COOH)_2$$

Benzene — Cyclohexane — Adipic Acid

$$\xrightarrow[-H_2O]{+NH_3} (CH_2)_4(CN)_2 \xrightarrow{H_2} (CH_2)_6(NH_2)_2$$

Adiponitrile — Hexamethylenediamine

$$(CH_2)_4(COOH)_2 + (CH_2)_6(NH_2)_2 \longrightarrow$$

Adipic Acid + Hexamethylenediamine

$$[HOOC(CH_2)_4COOH....NH_2\ (CH_2)_6\ NH_2]_x$$

Nylon Salt

$$[....CO(CH_2)_4CONH(CH_2)_6NH....]_x$$

A Nylon Polymer

The synthesis of intermediates was only part of the problem. Nylon polymer was an entirely new material with properties different from any previous synthetic product. It provided the first example of spinning fiber from a molten polymer (m.p.263°C) and required entirely different techniques from rayon spinning. Information was acquired only by painstaking experimentation at each step.

Manufacturing Process Outlined

The process as finally developed for the manufacture of nylon and its fabrication into yarn may be briefly outlined as follows:

Nylon salt is heated in an autoclave with addition of stabilizers to control molecular weight and viscosity. A long-chain linear polymer is formed with a molecular weight of 10,000 or higher.

The melt is converted to solid chips that are later re-melted and extruded through a spinneret to form filaments at a speed of 2,500 feet a minute. The filaments are then drawn out to about four times their original length in order to develop the desired textile qualities characteristic of nylon.

These operations sound simple enough, but some of the problems encountered were extraordinarily difficult. For example, a specially designed grid for melting the polymer was necessary because of the poor thermal conductivity of the polymer; pumps had to operate at 285°C with only polymer as a lubricant; special abrasion-resistant steels that did not soften or warp at 285°C were necessary; the spinning assembling required radically new engineering developments to produce the necessary fiber qualities.

All of these chemical, physical and mechanical engineering problems had to be solved and dove-tailed into a unified process before manufacture of nylon could be undertaken. In all, about 230 technical men and eight manufacturing and staff departments share the credit for making nylon the important part of American life it is today.

Questions College Men ask about working with Du Pont

WHAT ARE THE OPPORTUNITIES FOR ENGINEERS?

Most openings at Du Pont are for chemical and mechanical engineers, but opportunities are also available for industrial, civil, electrical, metallurgical, textile, petroleum and other engineers. Practically all types of engineering are required in the work of the ten manufacturing departments as well as in some of the staff departments. Write for the booklet, "The Du Pont Company and the College Graduate." 2521 Nemours Bldg., Wilmington 98, Delaware.

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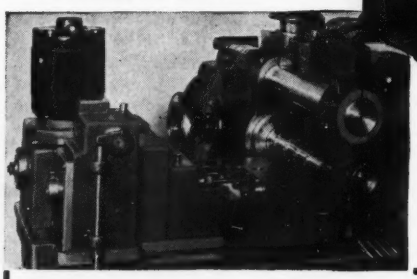

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look for the single ridge

OKONITE
insulated wires and cables
for every electrical use

Engineer-Scientist

(*Continued from page* 32)

science by bringing basic problems to the attention of the scientists, or by contributing to their solution?

Scientist to Engineer

We are accustomed to assume that scientific progress has resulted largely in a flow of ideas and fertile discoveries from the laboratories of the scientist to the waiting hands of the engineer. Famous examples of this sort of thing are not far to seek. It was the experiments of Oersted and Faraday that paved the way for the later development of the dynamo; it was the theoretical work of Maxwell which led to Hertz's discovery of electromagnetic waves and which in turn brought about Marconi's invention of wireless telegraphy. The great theoretical work of J. Willard Gibbs produced, virtually as a footnote or an aside, the highly valuable phase rule. Radar emerged as a modification—almost simultaneously hit upon by Young and Page in this country and by Watson Watt in England—of a well known method of exploring the ionized layers of the upper atmosphere by reflected pulses of radio frequency energy. The atom bomb—as every schoolboy knows by now,—was made possible by the whole structure of atomic physics, and particularly by the experiments of Professor Otto Hahn and Dr. Lise Meitner on the disintegration products of U-235. The examples of this sort of thing can be multiplied indefinitely, and the reader can doubtless supply a dozen more examples after a moment's thought.

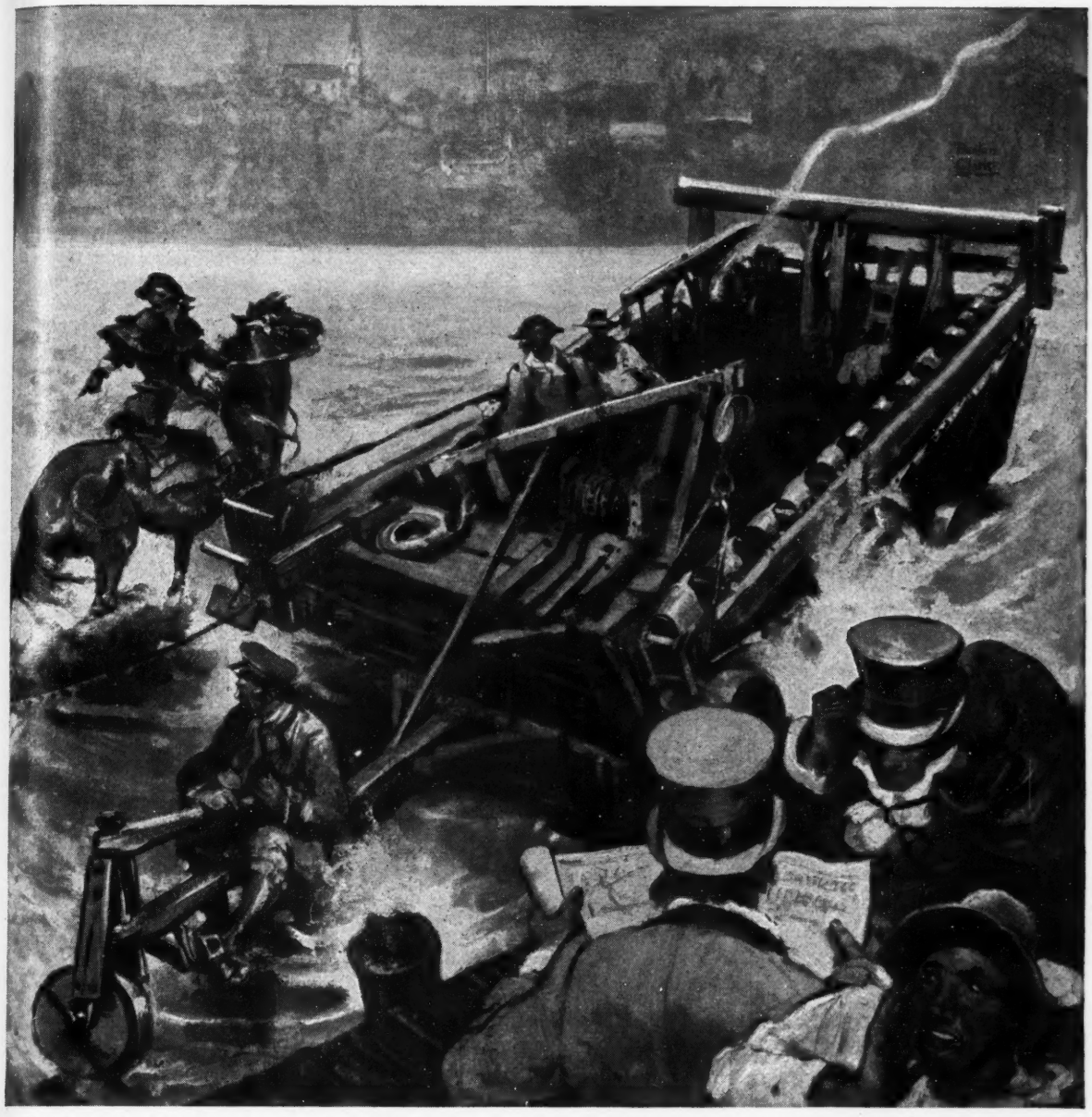
Practical Invention

It is less well appreciated how often theoretical science is beholden to practical developments that preceded it. We know that the practical inventor has not always or even frequently enjoyed a full theoretical understanding of devices which he has produced. It is rather the contrary in certain very familiar fields. Advances in aerodynamics, in electrical power transmission, and electrical communication followed upon the invention of the airplane, the dynamo, the telegraph and the telephone. Nor has research on these problems been confined to the great industrial laboratories designed for this special purpose.

No widely successful device—unless perhaps it was the filament lamp or the X-ray tube—was ever launched with a scantier theoretical background than the improved steam engine of James Watt. It was at least two generations before an approximately satisfactory theory of its operation was available. Before the steam engine was understood the study of heat was seriously undertaken, the great subscience of thermodynamics was elaborated, and physics was broadened and deepened and unified by the introduction of the concept of energy. It is not without reason that a friend of the author once observed that during the first fifty years of its existence Watt's steam engine gave far more to science than it received.

There is no better way to illustrate the point in question than by going still farther back in history and calling attention to the role

(*Continued on page* 36)



*The "Orukter Amphibolos," a steam-powered, amphibious dredge, built by Oliver Evans in Philadelphia, in 1803, shown emerging from the Schuylkill River.

His genius would have been futile without hard work

The "Orukter Amphibolos"* was more than a curiosity in 1803. An amphibious dredge, it began a new era — the mechanization of contracting industries. Its greatest claim to renown came from its inventor, Oliver Evans. First to design a high pressure steam engine, he built engines for pumping and hoisting, invented the elevator, conveyor, descender and the hopper for flour mills. But his foremost genius was for conscientious work . . . with that he made new industries possible.

American creative genius would have been futile without management ability and honest toil to develop our industries. This nation has become a beacon of hope for the world because sound management and conscientious work have together turned scarcity into abundance. We'll have that abundance in greater measure only if everyone realizes that even machines won't produce without an honest day's work to keep them going.

• • •

If Evans were alive, he would advocate the use of anti-friction bearings in contracting equipment. Made in every size and type that industry needs, SKF ball and roller bearings are found everywhere in modern, high speed contractor's machines. They helped to make Boulder Dam and other great construction projects possible; and everywhere they prove to be:

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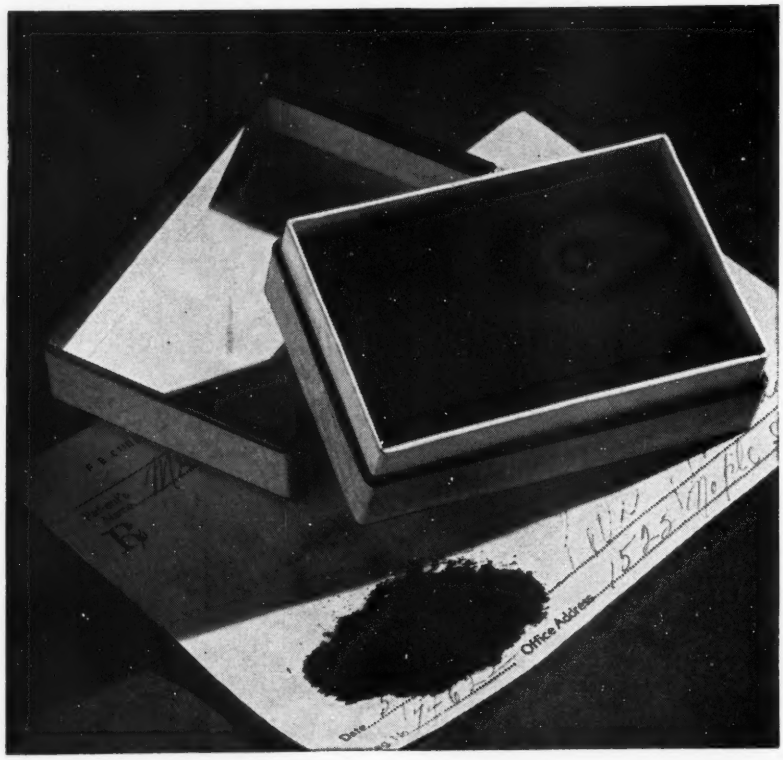

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CARBOLOY

*(TRADE MARK) CEMENTED CARBIDE

THE HARDEST METAL MADE BY MAN

Engineer-Scientist

(*Continued from page* 34)

played by the engineering profession—in its vigorous, sprawling infancy—in preparing the great revolution in physics that was launched by the work of Galileo in dynamics. The extraordinary fact emerges that classical physics was founded in the attempt to solve a practical problem that had beset the military engineers for two centuries before Galileo. In fact recent work in the history of science bestows very large credit upon the engineers of the fifteenth and sixteenth centuries for the great overturn of ideas brought about by the publication in 1638, of Galileo's *Dialogues on the Two New Sciences.* To understand how this was possible it is necessary to say something of Galileo's accomplishment and something also of the characteristics of the engineering profession in the early period, its duties and its paramount problems.

Thought Revolution

Galileo's greatest achievement was in consummating the final overthrow of a method of thinking about nature that had been popular, and virtually impregnable, for the previous three or four centuries. Among the "schoolmen" of the European universities truth was habitually sought by the *dialectical method,* i.e. by discussion and debate, and consisted in the main of drawing out tirelessly the special consequences of a small number of unverified and for the most part unverifiable assumptions. Thinking about nature was a harmless but unprogressive game played with an elaborate apparatus of formal logic and pretentious terminology. The nebulous, illusive meanings attached to the scholastic vocabulary would make their reasoning a chamber of horrors to a semantically trained modern. Scholastic thought rested almost entirely upon the important body of Aristotle's writings, perhaps the most ambitious and the most influential system of thought ever devised by a single mind. The writings of Aristotle purported to be a *summa* (a summation of all knowledge). They cover an extraordinary range of subjects,

(*Continued on page* 38)

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to investigate physical laws to extend scientific knowledge—or applied research to solve specific manufacturing problems, develop new apparatus.

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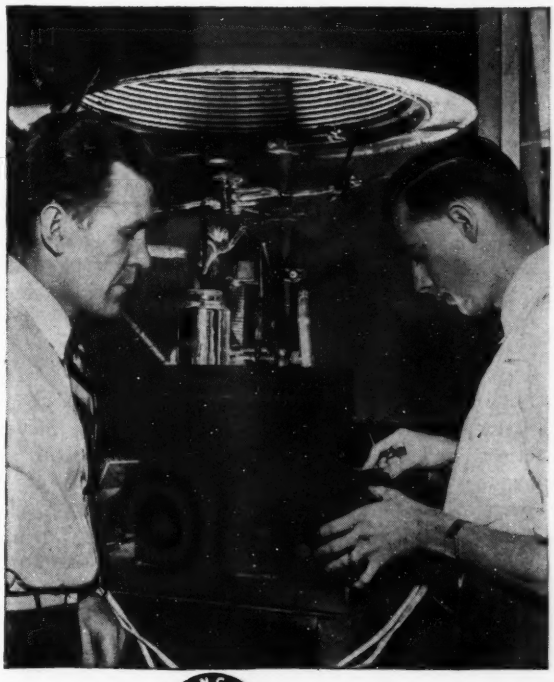

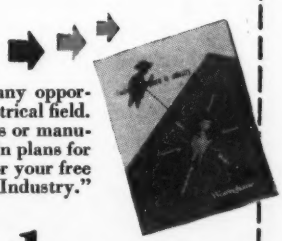

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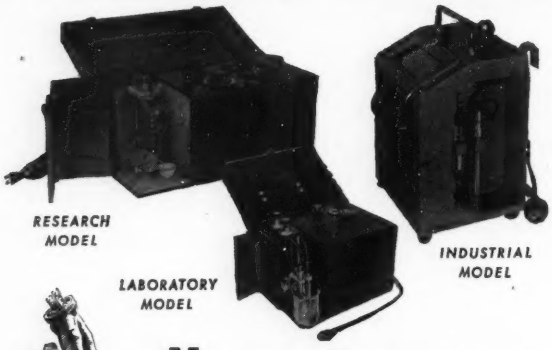

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MAXWELL T. KENDALL '36, *Headmaster*

Engineer-Scientist

(*Continued from page* 36)

in which only mathematics and the practical arts do not find a place. They include works of transcendent importance in logic, metaphysics, literary criticism, political science, ethics, and biology. Much of this can be read with profit today. In particular, Aristotle has important and very modern-sounding things to say about scientific method and the necessity of relying upon observation and experience and learning about nature from the experiences of practical men, fishermen, farmers, herdsmen, sailors, and so forth, who are constantly in touch with her. In this matter of the proper way of studying nature, Aristotle was not always able to follow his own excellent precepts, but he was far more modern than those scholastics of the later Middle Ages who claimed to be his disciples.

In his writings about the structure of the universe and the underlying characteristics of matter and motion, Aristotle was least successful; this was particularly unfortunate for his system, since he recognized the basic truth that the study of dynamics, the study of matter in motion, must be the foundation stone to the study of nature. The 16th and 17th centuries founded modern science on the wreckage of Aristotelian dynamics and of Aristotle's theory of matter. This was no mean achievement, since the system of Aristotle was a vast, towering, closely integrated structure. To impugn one portion was to threaten the rest, and those who were assaulting the portion pertaining to natural philosophy were rightly asked what they had to offer in its place.

Aristotle's "Motions"

Aristotle's theory of motion was not quantitive, but verbal and descriptive. There were two kinds or categories of motion which Aristotle distinguished as *natural motion* or *violent motion.* Natural motion took place in response to the basic tendencies of the universe, without the intervention of artificial or human agencies. Such was the supposedly circular motion of the heavens (the apparent motion of the celestial sphere); the rectilinear motion of heavy bodies falling to earth under the influence of gravity; and the reverse tendency of lighter bodies ("fire", smoke, etc.) to move upwards to their "natural place" in the universe. Violent motion, on the other hand, was that imparted to a body by some identifiable agent which exerted a force upon the body. An arrow, a projectile of any sort, was thought of as kept in flight by a persistence of the force which had launched it. Thus Aristotle believed that in some fashion air was able to store up this initial "force" and transmit it continuously to the projectile at all points of its trajectory. According to this theory natural motions and violent motions could not occur simultaneously, could not mix. Therefore it was concluded that gravity could exert an effect upon a projectile only after the initial launching force spent itself and had been overcome by air resistance; at this point the natural motion of gravitational free fall could begin to take place. A projectile moving according to these principles would not describe the smooth parabolic

(*Continued on page* 40)

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Engineer-Scientist

(*Continued from page* 38)

path we know to be followed, but would pass abruptly from a straight line of flight to a straight line of free fall.

The story of the overthrow of Aristotelian physics in the period of the Renaissance is complex and difficult to unravel. Criticisms arose from a number of quarters independently. Within the universities of Europe, within the scholastic world itself, there grew up a minority learned party, called the Moderns (the *Moderni*) who gave a greater place to mathematics in their thinking than did their more conservative colleagues and who were led to study the elementary problems of motion kinematically. This group pointed out serious faults in Aristotelian dynamics and proposed a modified theory of motion that seems to have had a great influence upon Galileo. Their most important innovation was the introduction of the idea of *momentum* to account for the motion of projectiles.

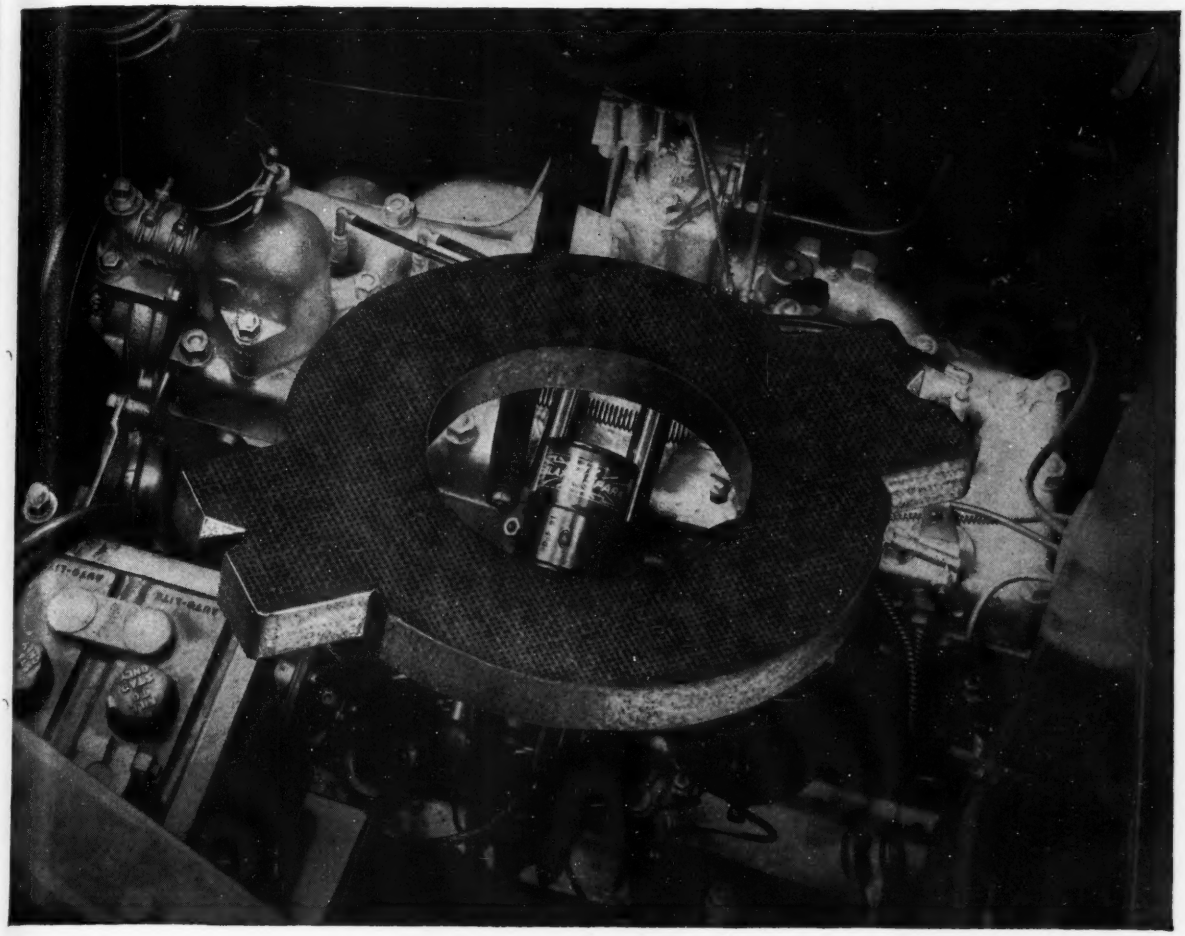
A second factor was the rediscovery (and the multiplication by the printing press) of works of classical Antiquity which had not been available to the Middle Ages and which embodied views at variance with Aristotle .These included the works of Archimedes, which not only served as a model of how mathematics could be applied to the study of matter, but were based on assumptions as to matter and motion which departed sharply from the views of Aristotle. Thus the notion of *specific gravity* in Archimedes is clearly in opposition to Aristotle's ideas that of the two kinds of rectilinear natural motion and to his application of "final causes" to explain the motion of bodies moving upwards or downwards.

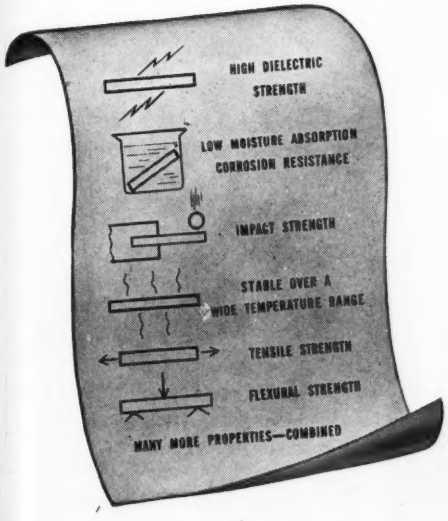
A most important factor is to be found in the changes that were taking place in the conditions of life during the 15th and 16th Centuries and which brought with it reintroduction of machines in large numbers. Machines of many kinds had been known in antiquity but experience with them had been lost during the dark ages. A growing preoccupation with practical problems involving them threw into relief the prevailing ignorance of mechanics and dynamics .In the face of steadily growing experience with mechanical systems and with new machines and new devices used in peace and war, the inadequacy of prevailing physics was clearly evident, and the absurdity of Aristotle's dogmas about motion became generally apparent. From the engineers who were preoccupied with the new machines and the new problems—from men like Leonardo da Vinci and Nicolo Tartaglia—came some of the most damaging criticisms of Aristotle. They brought the evidence of their own experience to support the more theoretical criticisms of the *Moderni* whose modifications they were quick to adopt.

The engineer, who had been an important figure in the later centuries of antiquity, reappears at the close of the dark ages. As the master of the engines used in medieval

(*Continued on page* 42)

Plastics where plastics belong for resistance to wear and moisture





Synthane where Synthane belongs

HERE's Synthane (our type of laminated plastics) at work in the water pump of a popular car, where resistance to wear and moisture are important.

This seal washer is lapped to fit precisely, seals watertight without packing, resists—mile after mile—the inroads of engine cooling water. It's an appropriate job for moisture-resistant Synthane, a good example of using plastics where plastics belong. Synthane has many other unusual mechanical, electrical, physical and chemical properties. It is light (½ the weight of aluminum), dense, strong, resists heat, impact, corrosion, is a good electrical insulator, and easily machined. It is a practicable material for a limitless number of applications. Synthane Corporation (Key Address) Oaks, Pennsylvania.

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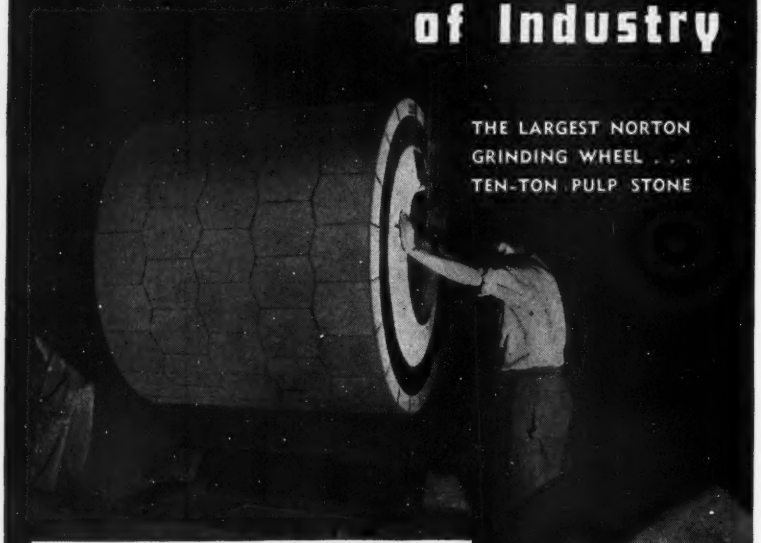
NORTON Meets Every GRINDING WHEEL Demand of Industry



GRINDING has a part in producing almost every object with which you come in contact throughout the whole day—from the alarm clock that wakes you in the morning to the typewriter on which you tap out that lab report at midnight.

And Norton has a wheel for every grinding job. They range from the gigantic ten-ton pulpstones that grind wood into pulp for your newspaper to the tiny wheels used by makers of delicate instruments for the laboratory.

There are wheels of ALUNDUM abrasive (aluminum oxide) for grinding steels, wheels of CRYSTOLON abrasive (silicon carbide) for the non-ferrous metals and for non-metallic materials, and wheels of genuine diamonds for grinding the cemented carbides, glass, ceramics, stone and other super-hard materials.

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LABELING MACHINES (BEHR-MANNING DIVISION COATED ABRASIVES AND SHARPENING STONES)

Engineer-Scientist

(*Continued from page* 40)

siegecraft he was almost indispensable in the warfare of the day. The name *ingeniator* appears regularly in official documents from the time of the Norman conquest onward. By the middle of the fourteenth century the engineer was compelled to master the new artillery based on the use of gun powder as well as the more primitive siege engines and catapults inherited from antiquity. In the fifteenth century, a transition period in which both the old and the new artillery were employed, we know the names of a number of distinguished engineers some of whom have left manuscript sketchbooks which give us some idea of the wide variety of machines and military devices, some doubtless existing only in their fancy, with which they were preoccupied. This tradition exerted a profound influence upon Leonardo da Vinci, whom we can think of as the greatest of the early school of engineers.

What is probably the first engineering book to come off the printing presses of Europe is a military encyclopedia by Roberto Valturio, written in 1460 and published in 1472. It is illustrated by woodcuts showing all manner of military devices: catapults, rams, scaling ladders, war chariots and many other contrivances. The figures accompanying this article are reproduced from Valturio's work: a block-and-tackle for hoisting cannon; transportable bridges and paddle-wheel boats for military purposes. Leonardo da Vinci, whose inventive genius and extraordinary mechanical sketches are doubtless known to every reader, was strongly influenced by the book of Valturio.

Leonardo was the first of the engineers to concern himself with the current theories about motion, and in his notebooks have been discovered bold speculations on the question of motion together with a clear rejection of Aristotle's theories. From his own studies Leonardo came to understand the general properties of the trajectory of projectiles, and had recourse, not to

(*Continued on page* 44)

". . . Ignorance is the curse of God, knowledge the wing wherewith we fly to heaven."—SHAKESPEARE

Why some things get better all the time

HOOP SKIRTS AND PRINCE ALBERTS are only fond memories now. Far smarter the styles of today . . . and equally striking are the constant *improvements* in the *quality* of clothing.

There now are beautiful synthetic fabrics, in stunning variety—all made possible by chemistry. And woolens, cottons and other fabrics are processed and dyed more effectively—thanks to special new chemicals, and equipment of stainless steel. There are eye-catching hat decorations, smartly styled footwear, buttons, belts and suspenders of colorful long-life plastics. And rainwear of vinyl plastics provides new comfort and protection in stormy weather.

Clothing for just about any occasion is today more attractive and more serviceable than ever before . . . because it is made of things that are *basically better.*

Producing better basic materials for the use of science and industry and the benefit of mankind is the work of UNION CARBIDE.

Basic knowledge and persistent research are required, particularly in the fields of science and engineering. Working with extremes of heat and cold—frequently as high as 6000° or as low as 300° below zero, Fahrenheit—and with vacuums and great pressures, Units of UCC now separate or combine nearly one-half of the many elements of the earth.

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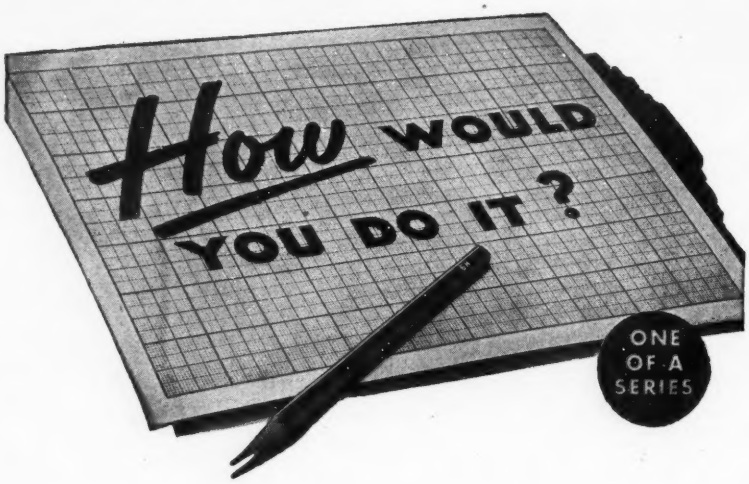

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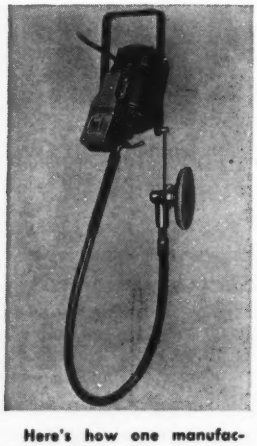

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Engineer-Scientist

(*Continued from page* 42)

the explanations of Aristotle, most commonly invoked in his day, but to the theory of *impetus* or momentum favored by the critics of Aristotle.

The next figure of importance in the history of the trajectory problem is another engineer, Nicolo Tartaglia, who in the middle of the sixteenth century reached qualitative conclusions about trajectories that were similar to those of Leonardo. From his modified theory of motion he deduced that the path of a projectile must be a smooth curve though he was unable to determine its properties. His conclusions were published in what was principally an artillerist's handbook. This work, published in 1546, dealt with a wide variety of practical problems of military importance, yet ended with a critical appraisal of Aristotelian mechanics.

There seems to be little doubt that the disputes about the trajectory of projectiles and the obvious inadequacy of Aristotle's dynamical principles gave rise to Galileo's celebrated *Dialogues* on mechanics. Galileo himself tells us that his interest in mechanical problems was stimulated, and his curiosity whetted, by frequent visits to the Venetian arsenal while he was teaching at the nearby University of Padua.

The great discoveries in dynamics recorded in the *Dialogues on the Two New Sciences* are all steps in the solution of the trajectory problem. The quantitative enunciation of the principle of momentum which became Newton's first law; the determination of the law of free fall; and finally the principle of the vector addition of velocities were all, in Galileo's mind, contributory to solving the persistent problem of the cannon ball in flight. Yet upon these discoveries was reared the entire structure of classical physics. What Galileo referred to modestly in a letter to a friend as "my book on ballistics," and which he evidently thought of as a work of what we would call applied science, has had a far greater influence upon pure science than many works with greater theoretical pretensions.

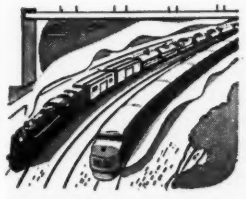
We're not so hot on POGO STICKS

Lots of people like to play jack rabbit. Still, as a way of going to work every morning, we don't see much of a future for Pogo Sticks. Not even *aluminum* Pogo Sticks.

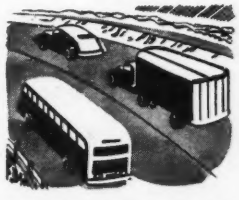
But mention any other means of locomotion or transportation and our aluminum "Imagineers" get a gleam in their eyes. After all, what is more logical than vehicles made of aluminum? Less weight to move. More payload.

We turned our imagination loose on that idea years ago . . . then engineered our thinking into trains, trucks, planes, ships. Alcoa's Development Division has a staff of "Imagineers" who think of nothing else but better ways to transport people, products, and materials by using aluminum. Actually, we have *four separate* staffs of transportation engineers, one each on railroads, highway vehicles, ships and aircraft.

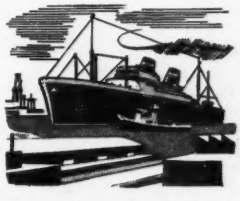
Whatever you do after college, you'll benefit from that. If you go into transportation, these Alcoa engineers will be working with you to cut costs, speed schedules, improve facilities. Or if you choose some field of production, they'll be helping to transport your materials and finished goods cheaper and faster. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pennsylvania.



Passenger streamliners, refrigerator cars, hopper cars and tank cars built of Alcoa Aluminum are serving American railroads.



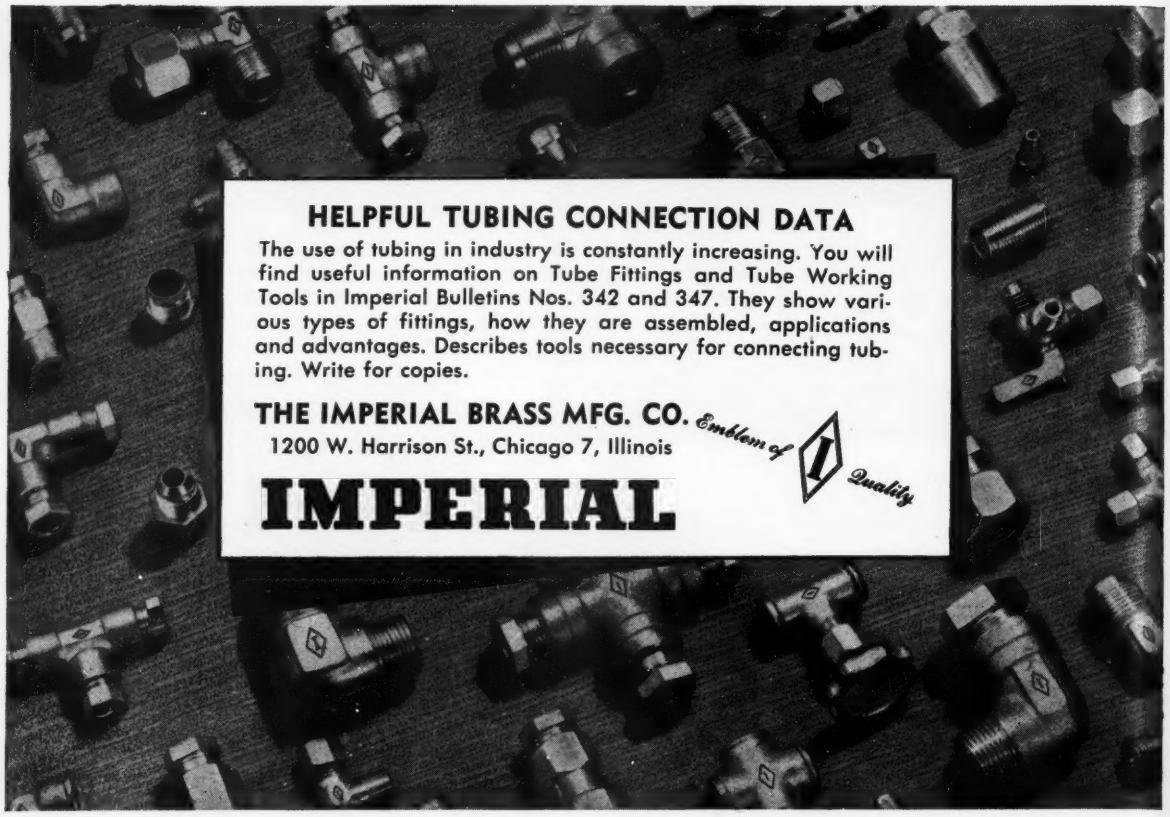
Alcoa Aluminum is finding more and more uses in buses, trucks and trailers. Yes, in passenger car manufacture, too.



Newest thing in shipbuilding is the aluminum superstructure, developed by Alcoa with marine architects and engineers.

Ever since Kitty Hawk, Alcoa has worked with the aircraft industry in developing better aluminum for better planes.

ALCOA FIRST IN ALUMINUM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New Books

(*Continued from page* 23)

able job. Many will feel that the omission was an unnecessary one and that the resulting limitation has not been justified.

B. J. Conta
Associate Prof.
Heat-Power Eng.

PRINCIPLES OF RADAR. By members of the staff of the MIT Radar School.

The advent of Radar into the War picture posed two important problems. First, the production in huge quantities of the necessary technical apparatus and secondly the training of the necessary operating and supervisory personnel. The training of the operating staff did not impose great difficulty since, as long as the apparatus is in perfect operating condition the requirements are simple, but when something goes wrong and expert knowledge of working principles and circuits is required, the problem is entirely different.

It was to train this latter group that Dr. W. T. Barrow of the Staff of MIT oragnized the first Radar School in Cambridge in June, 1941 and it was for use as a text in this school that *Principles of Radar* was prepared. The level of the book is directed to one with a fairly substantial background in physics and electrical engineering which might be required for the undergraduate degree in these fields. The coverage is voluminous and gives a complete discussion of not only the underlying theory involved in the operation of the various units of the radar system, but also practical information as to its application in some of the earlier radar sets now declassified by the Government. At the present time, it appears to be the only available publication to cover the field in the detail that it does since it must be remembered that earlier publications were severely restricted as to content by the requirements of National Security.

It is to be heartily recommended to the technical reader interested in radar and kindred problems.

Prof. William Ballard
Professor Elec. Eng.

Bob Beach

(*Continued from page* 18)

regimental commander of the V-12 unit.

At the next elections of the Board of Control, Bob was made president. Because of his all-around achievement, the Dean of the college nominated Bob to "Who's Who Among Students in American Universitys and Colleges". The nomination was accepted and his name appeared in the 1945-46 edition.

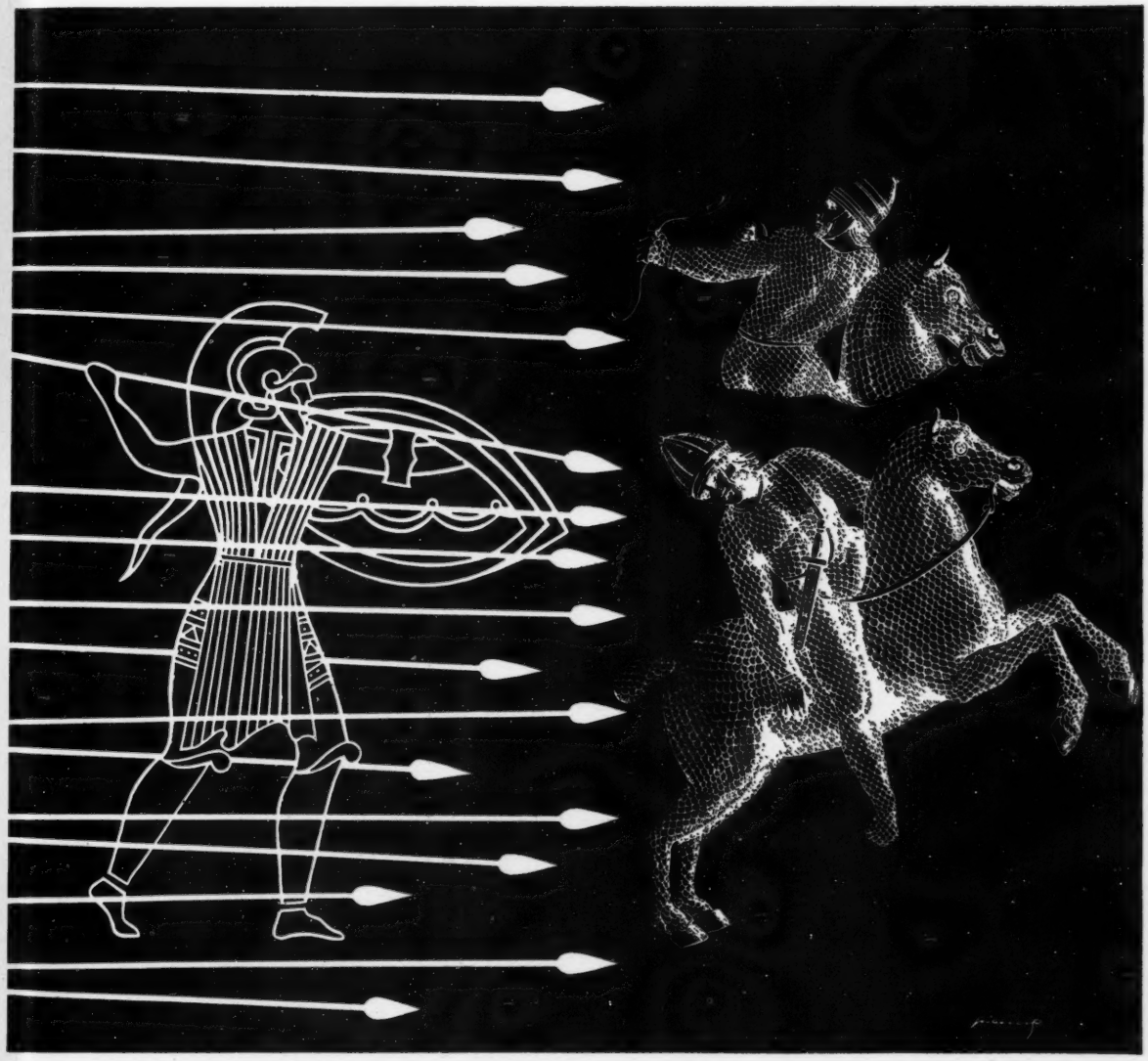
In November of 1945, the Navy transferred Bob to Cornell to pursue a course of study in mechanical engineering. Upon discharge from the Navy in February of this year, Bob had decided upon AE-ME as a career and he therefore returned to Cornell immediately.

At present Bob is a member of the NROTC unit, and is an active member of the Cornell chapter of Theta Delta Chi. Upon graduation in June of '48, he hopes to work in the field of sales promotion, which we feel should be a "natural" for him.

THE MACEDONIAN SURPRISE PARTY

When the proud Persian hordes plunged headlong at Philip of Macedon's army, they were dumped into the minor leagues by an entirely new strategy, the phalanx: a solid wall of warriors sixteen ranks deep. Strength-in-depth withstood and defeated the impact of an over-confident enemy.

Molybdenum steels are economical means of getting the strength-in-depth called hardenability. With it, you're assured of dependable performance under severe service conditions. Practical facts are available to show you where molybdenum can go to work for you.



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Okinawan Road Construction

New Physics Synchrotron

Read the May Issue of the

Cornell Engineer

Out of Phase

(*Continued from page* 22)

Whether Professor Grantham has the pendulum charmed or his escape is a physical law became the object of a bull session at Japes one morning and one of the purists volunteered to show his faith by doing the experiment personally. And so it happened that this man of faith stood himself against the very same blackboard, held the very same ball to his chin, and released the pendulum. It may well be that he had not yet acquired the gentle touch required of experimenters. At any rate, as he let go the ball, he unknowingly gave it an extra shove. He stood there, confidently, with the same fire in his eye Steinmetz must have had when he got his first shock.

The pendulum zoomed out over the empty seats, paused, and started towards the victim. As he stood there watching the ball coming larger and becoming closer and closer, he "chickened", and ducked. The ball parted the hair on his head as it went by and crashed into the wall. It took fifteen minutes to revive the scientist, and he passed out again when he saw the dent in the wall. Rumours are flying that he transferred to Ithaca College. One thing is sure, he hasn't been seen around Rockefeller since that day.

* * *

A note of hope for downtrodden draftsmen: Stone walls do not a prism make . . .

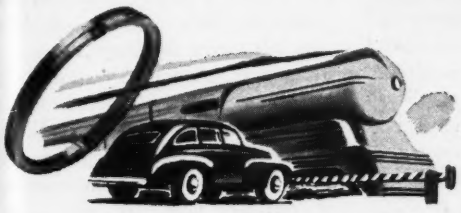
Techni-Briefs

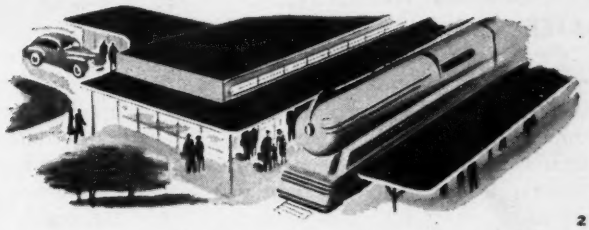
(*Continued from page* 20)

tom in steel frame buildings. Advantages include: working under cover after the top deck has been poured; slab construction time is cut to 1/3 the normal; long life of slab forms. *Construction Methods* reports that several steel frame buildings with concrete floors have been built in this way at a rate of one floor every two days.

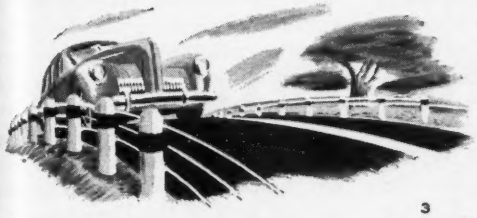
New aluminum alloys possessing high tensile properties and new zinc alloys that can be wrought as well as cast and have improved corrosion resistance have been developed by General Electric.

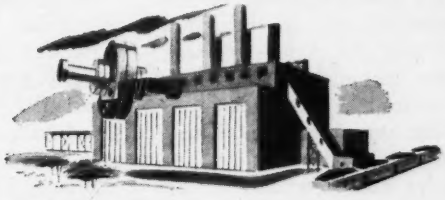
You saw us today...did you know us?





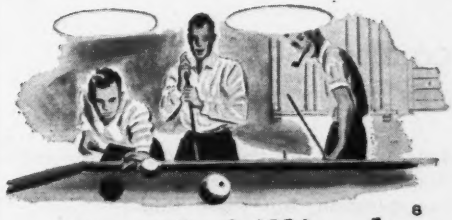
When you met the train[1] . . . . at the railroad station[2]





. . or drove along the[3] highway past a power plant[4] . . .

or past a coke plant[5] . . . . . mothproofed your winter clothes[6]



or took sulfa pills[7] . . . . . or played billiards[8] . . . . . .

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College News

(Continued from page 16)

AIEE

Physics and mathematics are the parents of engineering. It is proper, therefore, that the American Institute of Electrical Engineering should include in its convention agenda, a conference on mathematics.

Dr. Michel G. Malti, Professor of Electrical Engineering at Cornell University and Chairman of the Sub-committee on Mathematics, presided over the conference and, after some opening remarks stressing the relation of mathematics to engineering, introduced the following speakers:

Dr. John von Neumann of the Institute for Advanced Study, Princeton, who discussed the problem of electronic computers. These are the electrical robots which the press has so widely publicized and which do highly complicated mathematical computations much faster and more accurately than does their creator—man.

Dr. Mark Kac of Cornell University who dealt with probability as applied to electrical engineering problems and Mr. Charles Concordia of the General Electric Company, who discussed the applications of the differential analyzer.

The meeting was then opened for general discussion which was both lively and highly technical.

Nobel Awards

In an unprecedented ceremony, five Nobel Prize winners who are associated with Cornell University as faculty members or alumni were honored by that institution in the grand ballroom of the Waldorf-Astoria Hotel, New York City, on February 17. As a preface to the dinner, President Edmund E. Day of Cornell University gave a 15-minute address over a nation-wide hookup of the Columbia Broadcasting System on the subject, "The University in the Modern World."

Special scrolls were presented by President Day to Nobel Prize recipients Pearl S. Buck, Professor Peter J. W. Debye, John R. Mott, Dr. Isodor I. Rabi, and Professor James B. Sumner. The ceremony and addresses followed a banquet which was attended by alumni, faculty members and officials of Cor-

Citations outlining the achievements of the five honor guests were given by Cornell faculty members or officials who are also distinguished in the general fields of the Nobel Prize Winners. This latter group included Hans A. Bethe, professor of physics, who developed the theory of solar energy, and who was a division head at the Los Alamos Laboratories of the Manhattan Project; Morris G. Bishop, professor of romance languages; Dr. Vincent du Vigneaud, professor and head of the Department of Biochemistry at the Cornell Medical College in New York City; John G. Kirkwood, professor of chemistry; and Roger H. Williams, Cornell University trustee and member of the executive committee of the International Committee of the YMCA.

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NEW YORK 17,
NEW YORK

ITHACA OFFICE
SIBLEY DOME BLDG.
CORNELL UNIVERSITY
ITHACA, N. Y.

STRESS and STRAIN...

Engineer: New Year's Eve I made a resolution that beer would never touch my lips again.

Arts Student: And since then no beer has touched your lips?

Engineer: Nope! I'm drinking through a straw now.

* * *

The demure young bride, her face a revelation of winsome innocence, slowly walked down the church aisle clinging to the arm of her father. As she reached the platform, her dainty foot brushed a potted flower, upsetting it. She looked at the spilled dirt gravely, then raised her child-like eyes to the sedate face of the minister and said, "That's a hell of a place to put a lily!"

* * *

"Son, after four years of college, you're nothing but a drunk, a loafer, and a darn nuisance. I can't think of one good thing it's done."

"Well, didn't it cure Ma of bragging about me?"

* * *

"It's the little things in life that tell," said the co-ed as she yanked her kid brother from under the sofa.

* * *

J. Smith looked up the shaft of the Ithaca Hotel this morning to see if the elevator was coming down. It was. Age 45.

* * *

Research division: Liquor Test

Connect 20,000 *volts across a pint. If the current jumps it, the product is poor. If the current causes a precipitation of lye, tin, arsenic, iron, slag, and alum, the whiskey is fair. If the liquor chases the current back to the generator—You've got good whiskey.*

* * *

Soph: I was over to the drugstore having a tomato ice cream soda.

Frosh: That must taste awful—what's in it?

Soph: Two scoops of vanilla ice cream, some chocolate syrup, carbonated water and a cherry.

Frosh: What about the tomato?

Soph: She waited on me.

* * *

Little Cindy had not been observing the proper table manners, and as a punishment she was made to eat her dinner at a little table in the corner of the dining room. She was ignored by the rest of the family until they heard her saying grace:

"I thank thee, Lord, for preparing for me a table in the presence of mine enemies."

* * *

The brain of a college student is one of the most unusual things known to man. It starts to function the moment he jumps out of bed and doesn't stop until he reaches the classroom.

* * *

1st EE: "Busy?"

2nd EE: "No. You busy?"

1st EE: "No."

2nd EE: "Let's go to class then."

* * *

"Is that man rich?"

"Is he! He's so rich he doesn't know his son's in college!"

* * *

The Engineering coed had not completed many Mechanical Drawing assignments before she came up with the following definitions: A bolt is a thing like a stick of hard metal like iron, with a square chunk at one end and scratchings wound around the other. A nut is the same sort of thing, only opposite, being just a hole in a sawed-off hunk of iron with the wrinkles around the inside of it.

* * *

Judge to suspect: Where did you steal this silverware?

Suspect: From two fraternity houses on the hill, your honor.

Judge: Sergeant, call the downtown hotels and distribute this stuff.

* * *

A lawyer was attending a funeral when a friend, entering late, sat down beside him and asked, "How far has the service gone?"

The lawyer nodded toward the officiating minister and replied, "He just opened the defense."

* * *

Huddleston: I say, I'm frightfully sorry you buried your wife yesterday.

Nottingham: Had to. Dead, you know.

* * *

Married life is all billing and cooing. The cooing won't last a month but the billing goes on forever.

* * *

Professor's wife: Sonny tells me he caddied for you all afternoon.

Absent-minded professor: Come to think of it, that boy did seem rather familiar.

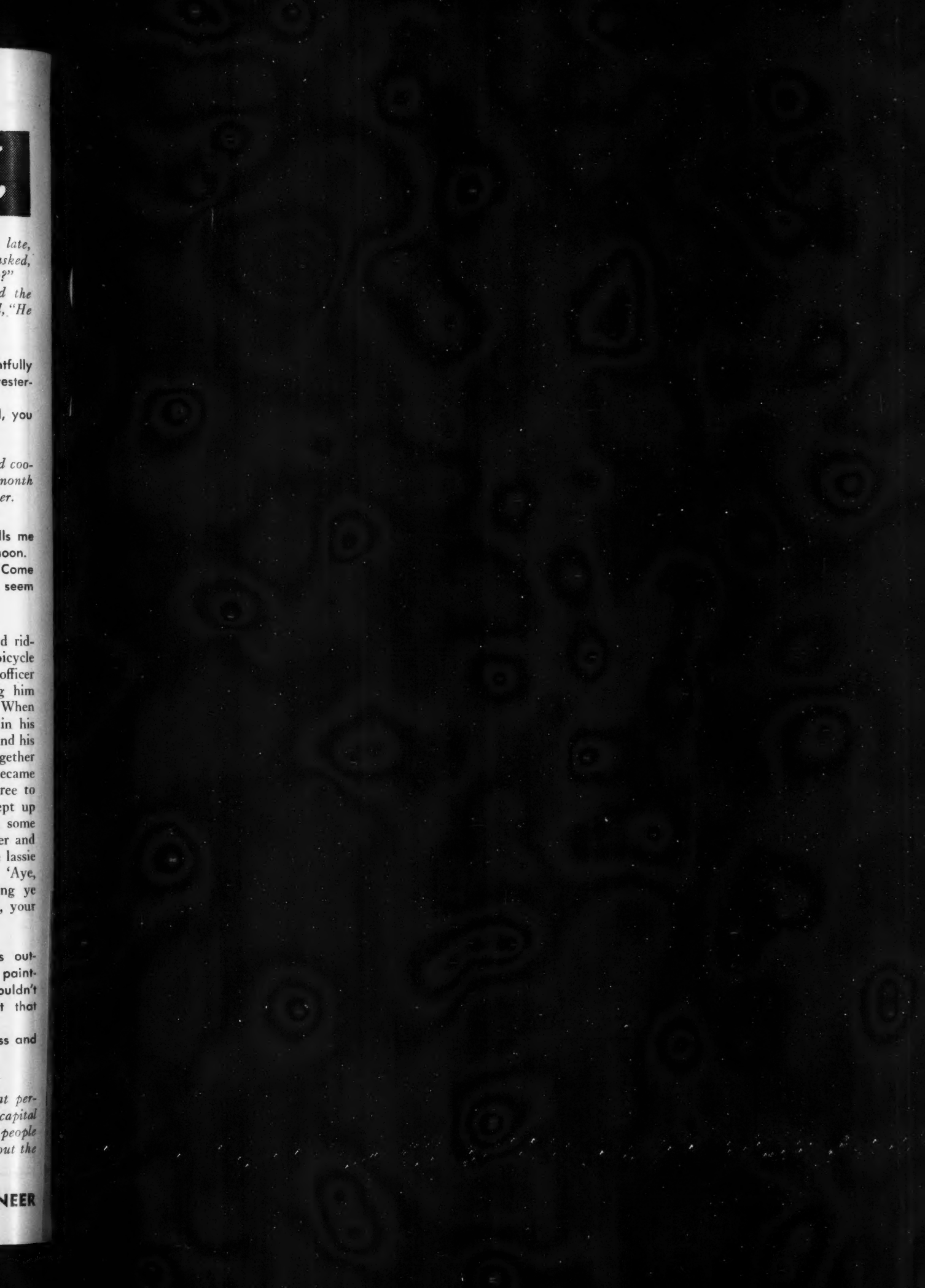
* * *

Sandy McTavish was found riding a bicycle with another bicycle strapped over his back. The officer took him to court, charging him with the theft of one bicycle. When asked by the judge to explain his story, Sandy related that he and his bonnie lass had been riding together in the country until they became tired and stopped under a tree to rest. "After some time, I crept up and stole a little kiss. Then, some time later, I cuddled up closer and stole another kiss. Me bonnie lassie sighed and whispered softly, 'Aye, Sandy, ye can have anything ye want.' So I took the bicycle, your honor."

* * *

Garage proprietor: That's outrageous! Fourteen dollars for painting this old shed? Why I wouldn't consider paying Rembrandt that price for the job.

Painter: Offer him any less and we'll picket the place.

* * *

Which makes us think that perhaps the trouble between capital and labor is that too many people are trying to get capital without the necessary labor.